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A SURVEY OF THE CARBOHYDRASE SYSTEMS OF SYNCEPHALASTRUM RACEMOSUM COHN

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The ability of microorganisms to survive and perpetuate themselves in given environments is largely dependent upon the efficiency of their enzyme systems. The key to survival in some special habitat may be the genetic ability to produce an enzyme allowing the primary utilization of a particular substrate. Studies on the distributive ecology of the filamentous fungi have largely ignored the interrelationships of the enzyme systems of these organisms, whereas such interrelationships have been the principal approach to the ecology of yeasts and related fungi. This situation perhaps results from the fact that efficient techniques for the measurement of growth and enzymatic activities of filamentous fungi have only recently become available. Since the carbohydrases are among the primary enzymes concerned in substrate utilization, a comparison of these systems in any series of isolates may well provide clues to the factors governing their distribution. To test this hypothesis, and also to accumulate data upon the potential value of enzyme systems as taxonomic criteria, a comparative study has been made of the carbohydrase systems of twenty-three isolates of *Syncephalastrum racemosum* Cohn, collected from diverse habitats. Grown upon a complete synthetic nutrient medium, these isolates are morphologically indistinguishable except for minor quantitative differences which have not proved consistent enough to warrant their classification as taxonomic entities. Throughout, attention has been focused upon the comparative behavior of these isolates in the presence of different carbon sources to determine whether there is a detectable relation between the carbohydrase pattern of the isolate and the substrate on which it was collected. It is realized, of course, that many other factors will influence the utilization of a given carbon source, but any direct correlation that might be made between the substrate on which the organism was collected and its enzyme systems would be of great potential interest.

MATERIALS AND METHODS

All the studies reported here were carried out upon a basal medium of the following composition:

Asparagine	2 gr.
KH_2PO_4	0.5 gr.
$MgSO_4$	0.25 gr.
Bacto ground agar	15 gr.
Distilled water	1000 cc.

This medium was autoclaved for twenty minutes at fifteen pounds pressure and the carbon sources, sterilized by passage through a Seitz filter, the added aseptically. The various carbon sources were supplied as molecular equivalents of forty grams of dextrose. The initial pH of the medium after sterilization was adjusted to pH 4.7 with 0.1N HCl and NaOH. The cultures were grown at 30° C. in Pyrex growth tubes of the type described by Ryan, Beadle and Tatum (1). The internal diameter of the tubes was 15 mm., the length 30 cm. All glassware was cleaned with chromic-sulfuric acid mixture and thoroughly rinsed before using.

A standard inoculum of one loopful of washed spores from a stock culture was introduced at one end of the tube and the culture allowed to grow forty-eight hours. Subsequently measurements were made at twenty-four-hour intervals for one hundred and forty-four hours. These measurements were in millimeters at the mycelial frontier. Each carbon source was tested in triplicate runs. To determine whether there were any marked changes in the enzyme systems involved, due to mutation or adaptation during continued culture, the experiments were repeated at approximately yearly intervals for a three-year period using stocks which had been maintained by serial transfer on a conservation medium of the following composition: Nutramigen (Mead Johnson Co.) 20 gr., Bacto ground agar 15 gr., distilled water 1000 cc. At the conclusion of these experiments stocks of the same original isolate which had been maintained in lyophil for the three year period were revived and also tested in triplicate for comparison. In only one case, described below, was there any significant difference between the growth rate of stocks kept in serial transfer or in lyophil.

With the system of measurement used here, the limit of reproducibility was plus or minus one millimeter. Any tubes which showed a marked deviation from the average beyond this limit, were rerun and, in the few cases where this occurred, it was traceable to faulty technique in inoculation or handling of the tubes. The material given in the graphs and tables below represents the average growth rate in millimeters over twenty-four hour periods at 30° C. of twelve runs on each carbon source (nine runs from serially cultured stocks, and three runs from the original stock carried in lyophil), taken over a three year period.

The following carbon sources obtained from the Pfanstiehl Chemical Company were tested: dextrose, d-mannose, l-sorbose, d-levulose, d-galac-

TABLE I

NO.	SUBSTRATE	LOCALITY	COLLECTOR	DATE
62	garden soil	Ithaca, New York	V. M. Cutter	1938
64	sporophore of Lactarius sp.	New London, New Hampshire	V. M. Cutter	1939
73	soil	Cold Spring Harbor, N. Y.	A. F. Blakeslee	1938
104	decaying humus	Panama, C. A.	V. M. Cutter	1938
109	decaying humus	Panama, C. A.	V. M. Cutter	1938
149	surface sterilized pea seeds	Ontario, Canada	J. W. Groves	1941
306	surface sterilized pea seeds	Wellington, Ontario, Canada	J. W. Groves	1943
324	mangel seeds	Eburne, British Columbia	J. W. Groves	1943
334	contaminant in blood agar plate	Duke U., Hospital, Durham, N. C.	N. F. Conant	1943
339	human hands with mycotic lesions	Duke U., Hospital, Durham, N. C.	N. F. Conant	1943
412	surface sterilized sweet pepper seeds	Pedrickton, N. J.	J. W. Groves	1942
479	decaying canvas	Milne Bay, New Guinea Is., S.W.P.A	W. L. White	1943
491	face piece, U. S. service mask	Solomon Is., South West Pacific Area	42 Chem. Lab. Co.	1943
497	from case of external otitis of human ear	Randolph Field, Texas	F. T. Wolf	1944
527	surface sterilized Red Clover seed	St. Anne de Bellevue, Quebec	J. W. Groves	1944
534	surface sterilized pepper seeds	Milford, Conn.	J. W. Groves	1944
549	decaying wood	Panama, C. A.	G. W. Martin	1944
551	Brazil nuts	purchased in New York City, probably from Venezuela	V. M. Cutter	1938
554	decaying leaves	Barro Colorado Island, Panaca, C. A.	G. W. Martin	1944
566	carrier, optical mask	Milne Bay, New Guinea, S.W. Pacific Area	42 Chem. Lab. Co.	1943
567	outlet valve on optical mask	Milne Bay, New Guinea, S.W. Pacific Area	42 Chem. Lab. Co.	1943
575	Japanese leather belt	Milne Bay, New Guinea, S.W. Pacific Area	Jeffersonville Q.M. Depot	1945
742	soil	Panama Canal Zone, Panama, C. A.	N R D C	1945

tose, sucrose, maltose, d-lactose, d-cellobiose, melibiose, d-raffinose, d-melizitose, d-arabinose, l-arabinose, d-xylose, soluble starch, l-rhamnose, d-mannitol, d-sorbitol, dulcitol, and glycerol. In addition, cellulose was used in the form of finely powdered Whatman #5 filter paper (80 mesh), and as regenerated cellulose prepared from the same filter paper. In no case were any of the isolates able to maintain growth on either type of cellulose although in all cases washed spores of the isolates germinated and some growth ensued. Since it was not possible to secure reproducible measurements on cellulose these data are not reported below.

The isolates used in these experiments were obtained from the sources and collectors indicated in Table I. Immediately upon receipt of the culture, single sporangiospores were isolated and used as the basis for monosporous lines. It should be emphasized that these sporangiospores are predominantly multinucleate, and hence in all probability heterocaryotic, since *Syncephalastrum* is a heterothallic organism. The stability and freedom from somatic variation displayed by these monosporous lines is probably traceable to this fact. In each case one monosporous isolate was selected from each original isolate and this line was immediately lyophilized in quadruplicate, and was also carried in serial culture on nutramigen agar under mineral oil. All stocks used were handled in this way.

RESULTS AND DISCUSSION

When the results of this study were plotted on the basis of average growth over twenty-four-hour periods, the data tabulated as bar graphs and these graphs superimposed on one another, eight patterns of behavior were immediately apparent in regard to the utilization of the respective carbon sources. These eight patterns are shown in Figs. 1–2. In assembling these patterns the growth data from individual isolates were compared for overall agreement. It was obvious that minor differences would occur between comparable isolates in growth rate and therefore in this particular comparison a discrepancy of plus or minus two millimeters for any given carbon source was allowed. The tabulated data all fall within these limits, and the figures as given represent the average performances of all isolates showing that particular behavior pattern when grown under the conditions of the experiment. In essence, these patterns constitute a key to the carbohydrase activity of this group of organisms since it is perfectly feasible to identify any of these isolates by repeating the above procedure, plotting the results schematically and superimposing the specific bar graph on these established patterns. This removes to a considerable extent the element of opinion in classifying the subspecific entities of *S. racemosum* on the basis of carbon utilization.

Perhaps the most striking feature of the carbohydrase systems of *S. racemosum* is their high overall efficiency. All the sugars tested can be utilized to some extent as growth substrates by most of the isolates. This high enzymatic efficiency may be reflected in the wide distribution of

Syncephalastrum both geographically, and with regard to substrates. There is little evidence that ability to utilize carbohydrate is a limiting factor in the ecology of the genus.

Although at this time sufficient data is certainly not available to determine the direction of evolution of these enzyme systems, certain trends may be discerned. Pattern 1 is very generalized and there is less variation in the ability to utilize all the sources than in any other pattern. It will be noticed that sucrose is a good carbon source for these isolates and that in the succeeding patterns this sugar is less effective. It is also apparent that sorbose, d-arabinose, rhamnose and dulcitol are poor sources for this group of isolates, and a glance at Fig. 3 where the utilization of carbon sources by pattern is diagrammatically represented, brings out the fact that this tendency is generally true throughout the group. In pattern 1 it will also be noted that the disaccharides are generally as good sources as the monosaccharides, a relationship which undergoes marked changes in the succeeding patterns.

In pattern 2 the utilization of disaccharides in relation to monosaccharides falls off sharply, while at the same time the ability to utilize the pentose sugar l-arabinose, and the alcohols, mannitol and sorbitol, is accelerated. These isolates are also characterized by their very poor utilization of starch and their good utilization of glycerol.

These tendencies are maintained in pattern 3 but lactose utilization becomes very poor, xylose becomes a relatively good source and these isolates have almost lost their ability to use rhamnose. Pattern 4 shows many similarities with pattern 3, but it is marked particularly by the poorer use of sucrose and the much better utilization of rhamnose.

Pattern 5 illustrates a reversal in several directions. Sucrose is hardly used. The trisaccharide, raffinose, is an excellent source and growth on sorbitol becomes comparatively better than on mannitol. This is a very vigorous strain showing better utilization of more carbon sources than any other group and greater extremes of activity are present here than elsewhere.

The remaining three groups are all depauperate and are characterized by poor usage of sucrose. Pattern 6 is interesting since, of the four isolates with this behavior pattern, two can use rhamnose and two cannot. This might be of significance in interpreting the evolution of these patterns. Both patterns 6 and 7 show dextrose to be a poor source relative to the other hexoses. The major difference between the two patterns is the fact that in 7, xylose becomes a better source than l-arabinose, thus reversing the previous tendency. This characteristic is culminated in pattern 8 where xylose becomes the best carbon source.

It should be obvious from a survey of this sort that we cannot at present comment intelligently upon the significance of these patterns in terms of speciation. Since all these variations exist within a complex of morphologically indistinguishable forms, some mycologists would feel that these patterns are sufficient basis for the establishment of specific units. Certainly in the past, species have been erected upon much less tenable bases. We

question, however, what useful ends may be served by the further subdivision of the species since *S. racemosum* is an easily recognized coherent entity. It seems certain that further research would reveal other patterns of carbohydrate utilization within isolates of this species, and it does not seem too much to expect that, ultimately, isolates may be found which span the entire range of utilization for each respective carbon source. In the interim, sufficient data have accumulated to warrant the statement that in regard to carbohydrase systems *S. racemosum* is a species showing a considerable degree of evolution.

We come finally to the question of a correlation of the carbohydrase pattern of individual isolates with the substrate from which they were collected.

TABLE II

	CULTURE	SUBSTRATE	LOCALITY
Pattern 1	527	clover seed	Quebec, Canada
	567	plastic valve	New Guinea
Pattern 2	479	decaying canvas	New Guinea
Pattern 3	339	human hands	North Carolina
	334	blood agar	North Carolina
	742	soil	Panama Canal Zone
Pattern 4	551	Brazil nuts	S. America
	566	canvas cover	New Guinea
	575	leather belt	New Guinea
	549	decaying wood	Panama
Pattern 5	554	decaying leaves	Panama
Pattern 6	64	sporophore of Lactarius sp.	New Hampshire
	109	decaying humus	Panama
	62	garden soil	Ithaca, N. Y.
	306	pea seeds	Ontario, Canada
Pattern 7	149	pea seeds	Ontario, Canada
	491	face piece on mask	Solomon Islands
	497	external otitis of ear	Texas
	534	pepper seeds	Connecticut
Pattern 8	412	pepper seeds	New Jersey
	324	mangel seeds	British Columbia
	104	decaying humus	Panama
	73	soil	L. I., N. Y.

Table II, where the isolates are arranged according to pattern, substrate and locality, shows very clearly that there is no defensible correlation between the substrates upon which these organisms were encountered in the field and the carbohydrase patterns of the individual isolates. It will also be noted that there is probably no geographic coincidence in the carbohydrase patterns of these isolates. It must be remembered that our field collection techniques for the mucoraceous organisms are still so crude that it is probably unfair to attempt such a correlation at all. In reality all our present isolation techniques tell us, in the case of a saprophytic organism

such as *Syncephalastrum*, is that at least one spore of this organism happened to be on that particular substrate at the time collections were made.

In terms of the taxonomy of *Syncephalastrum*, the most important contribution of this study lies in a consideration of the growth behavior and change in morphology exhibited by any one of these isolates grown upon different carbon sources. It was previously stated that when grown upon a complete medium these isolates were indistinguishable. In contradistinction to this, when any one isolate is grown upon different carbon sources a tremendous degree of morphologic variation is immediately apparent. That such must be the case is readily understandable from the differences seen in the growth rate of any isolate upon different carbon sources. These rate differences are the reflection of different morphogenetic tendencies in the individual colony. It would hardly be an exaggeration to say that within the range of morphologic variation expressed by one isolate upon the carbon sources used here, under the conditions described above, may be found the entire range of variation described in the literature on the genus *Syncephalastrum*. To state this in another way, it is possible by selecting any one of these isolates and varying the carbon source appropriately, to produce cultures identical with the several described species of *Syncephalastrum*. This in itself is not surprising since this genus is little known and all the species were described before present day cultural techniques were in vogue. Yet if this premise is true, there can be little justification at the present time for random description of taxonomic entities in such a group without previous exhaustive physiological studies to determine the extent of variation under standard conditions. At the same time a caveat should be sounded concerning the interpretation of such growth data in terms of the ability of organisms to survive under given conditions. Growth rate as such is only one aspect of assimilation and a slow growth rate is not *a priori* evidence of poor utilization. A case in point is the utilization of sorbose by this organism. Figure 3 shows that all these cultures grow very slowly upon sorbose. As has been pointed out elsewhere (2) the total dry weight of *Syncephalastrum* cultures grown upon sorbose and upon sorbose in combination with other sugars compares rather favorably with cultures grown upon dextrose. The slow growth rate on sorbose is not due to poor utilization alone but to a morphogenetic change in the form of the mycelial cells which under these conditions become shortened and ovoid, or even yeast-like, instead of assuming their normal elongated cylindrical shape. To this extent the data presented here may be misleading, but in the morphogenetic changes which can readily be detected in this manner may lie the key to an understanding of specific variation.

Since the data presented above deals exclusively with the carbohydrase systems of the somatic haploid stages, it was of some interest to discover whether the sexual reproductive cycle of the organism could be correlated in any way with these carbon utilization patterns. Therefore, compatible strains of *S. racemosum* were crossed upon the medium used above with all the individual carbon sources, at the same concentration on which the

growth rate studies had been made, and these crosses were tested for their ability to form zygospores upon the different sugars used. The results in terms of the presence or absence of zygospores are presented in Table III.

TABLE III

	479 x 554	479 x 551	479 x 534	479 x 104	64 x 534	62 x 534		479 x 554	470 x 551	479 x 534	479 x 104	64 x 534	62 x 534
Dextrose	+	+	+	+	+	+	d-Melizitose	–	–	–	–	–	–
d-Mannose	+	+	+	+	+	+	d-Arabinose	–	–	–	–	+	+
b-Sorbose	–	–	–	–	–	–	l-Arabinose	+	+	+	–	+	+
d-Levulose	+	+	+	+	+	+	d-Xylose	+	+	+	+	+	+
d-Galactose	+	+	+	+	+	+	Soluble starch	+	+	+	+	+	+
Sucrose	+	+	+	+	–	–	l-Rhamnose	–	–	–	–	–	–
Maltose	+	+	+	+	+	+	d-Mannitol	+	+	+	+	+	+
d-Lactose	–	–	+	–	+	+	d-Sorbitol	+	+	+	+	+	+
d-Cellobiose	+	+	+	+	+	+	Dulcitol	–	–	–	–	–	–
Melibiose	+	–	+	–	+	+	Glycerol	+	–	+	–	+	+
d-Raffinose	+	+	+	+	+	+	Cellulose	–	–	–	–	–	–

In general the carbon sources which did not promote rapid vegetative growth did not favor zygospore formation. Thus no zygotes were formed in crosses carried out on sorbose, melizitose, rhamnose, dulcitol, and cellulose. In the case of other negative crosses the degree of compatibility of the respective strains appeared significant when the crosses were made upon certain sugars. Crosses 479x551 and 479x104 failed to produce zygotes on nine and ten carbon sources respectively, and likewise on all the carbon sources which permitted zygote formation their reaction, as judged by the number and size of the zygotes produced, was weak compared to the other crosses. Since it has been shown many times by various workers in the Mucorales that vegetative vigor is one of the necessary prerequisites to successful gametic reproduction, it is not surprising to find that in any cross where one or the other compatible member is somewhat limited in its ability to assimilate the particular carbon source the zygospore production will be scanty. Likewise in the case of crosses 62x534 and 64x534 no zygotes were produced on sucrose, which would be expected since none of these isolates can assimilate sucrose to an appreciable degree. It will take further study to evaluate the specific role of carbohydrate assimilation in gametic reproduction and zygospore formation in *Syncephalastrum*, but the results of this survey substantially confirm the classic idea that successful sexual reproduction in this group is in large measure based upon proper environmental conditions and that the carbon source of the substrate is a prime requisite in this connection.

Finally we must consider the affect of mutation and adaptation of these enzyme systems upon their usefulness as taxonomic criteria. If such phenomena produce great variation in these cultures with time, any system of

classification based upon cultured material will hardly be workable. On the basis of the results obtained by many other workers on carbon utilization in microorganisms, one would expect that at least some of these carbohydrase systems would be adaptive. With the method used above it is not possible to detect adaptation if it occurs at any time except during the actual period of testing of a culture. The only check that may be obtained on this is by repeating the experiments at intervals and investigating the closeness of agreement in the results. Even this procedure will not adequately separate the phenomena of adaptation and mutation if they may be considered different processes. Our results given here would indicate that if adaptation occurs it has very little effect in creating greater variability of the cultures over a three year period. On the other hand spontaneous somatic mutations which allow better utilization of a particular carbon source may be readily detected by this method. Only one such mutant was encountered during the course of this work. In the case of isolate 742 in pattern 3, which cannot utilize rhamnose, in one run after a period of four days of very slow growth the culture suddenly began to grow at an average of 8 mm./24 hours. Contamination was suspected and a new run from the original stock confirmed the fact that some change had occurred in the tube in question. When the aberrant culture was checked for its behavior on the other carbon sources it showed the typical behavior of pattern 3 except in regard to rhamnose utilization. This was interpreted as fairly convincing evidence of a mutation at a locus controlling rhamnose utilization. Indirect evidence for the same type of mutation may be seen in pattern 6, where of four isolates showing practically identical behavior on all other sources, two can use rhamnose and two cannot. These may be interpreted as either gain or loss mutations at a single locus. However, in an organism such as this with multinucleate sporangiospores any somatic loss mutation will be so quickly submerged in the general population that it will not be the source of any great variation under the conditions used here. Gain mutations on the other hand, if they occur, will be easily detected by marked changes in the growth rate of individual cultures, and therefore should cause no difficulties when the procedures are used as bases for classification.

SUMMARY

1. The comparative ability of twenty-three isolates of *Syncephalastrum racemosum* to utilize twenty-one different carbon sources has been investigated. These isolates are shown to fall into eight carbon utilization patterns on the basis of growth rate studies.

2. The effect of carbon source upon the production of zygospores by compatible strains has been tested. It is shown that zygospores are produced on all carbon sources which support good vegetative growth, but that in the case of carbon sources which do not support vigorous somatic growth the degree of compatibility of the opposed strains is important in

determining the sexual reaction as judged by the number of zygotes produced.

3. The effects of adaptation and mutation of the genes controlling carbohydrase synthesis in this study are briefly discussed.

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It is a pleasure to acknowledge the technical assistance of Mr. Bruce Pollack, Mr. Morris Jalazzo and Miss Nancy Rhynedance during the period when this study was in progress. The author is also under great obligation to the late Dr. D. H. Linder and to Drs. J. Walton Groves, N. F. Conant, G. W. Martin, W. L. White, and F. T. Wolf, who at one time or another donated most of the cultures which made this study possible. This work was initiated and a portion carried out in the laboratories of the Department of Botany, Cornell University, and for the facilities provided there the author is duly grateful. A selected portion of this study was reported before the Microbiological Section of the American Botanical Society at the Washington Meetings, September, 1948.

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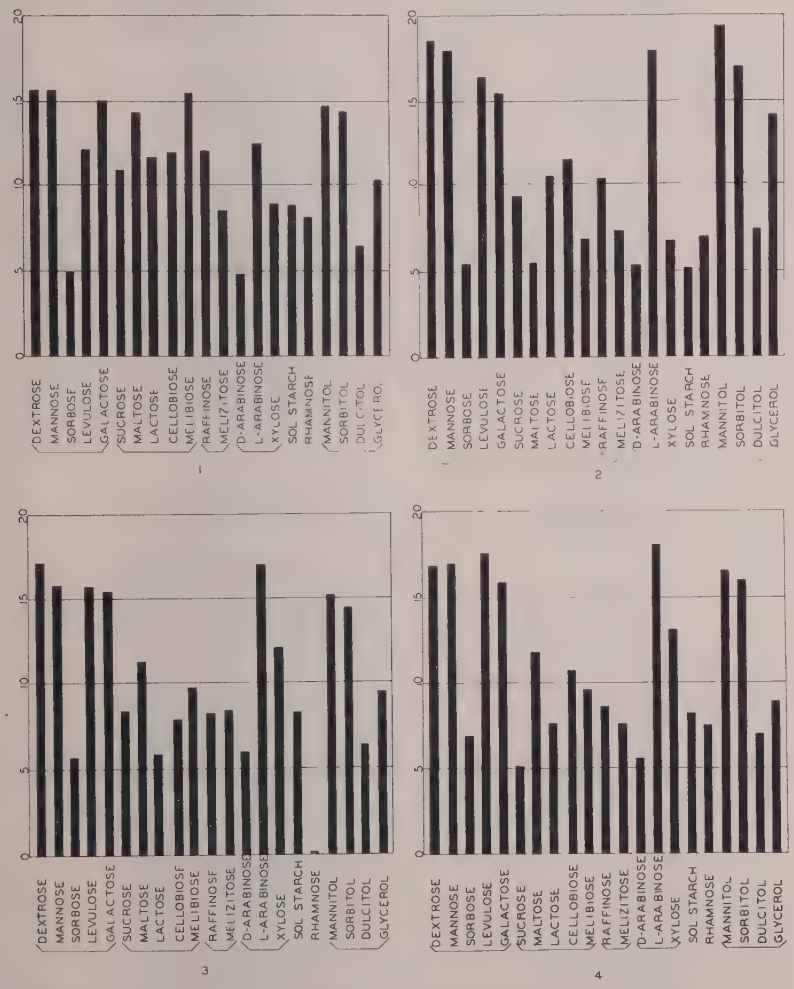

Fig. 1. Patterns 1, 2, 3, 4. Average growth in mms./24 hours for 144 hours on twenty-one carbon sources.

Fig. 2. Patterns 5, 6, 7, 8. Average growth in mms./24 hours for 144 hours on twenty-one carbon sources. In pattern 6 different rhamnose utilization levels indicated by cross hatching.

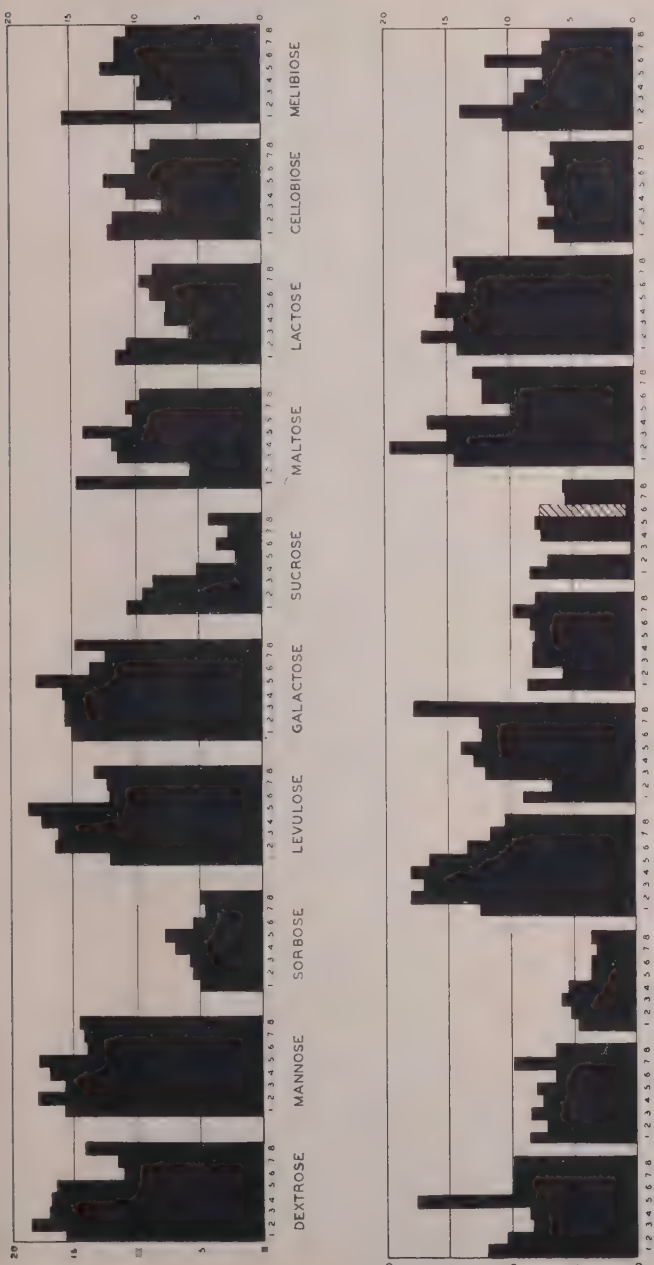

Fig. 3. Utilization of respective carbon sources by eight groups of isolates. Average growth in mms./24 hours for 144 hours.

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NOMINA CONSERVANDA PROPOSITA AND NOMINA CONFUSA — FUNGI. SUPPLEMENT

DONALD P. ROGERS

An earlier series of notes (Rogers 1949) was prepared by the writer in an attempt to consider critically most of the proposals for conservation of generic names of fungi. As there stated in a footnote, two important papers by Donk (1949, 1949b) on the same subject arrived after those notes had been set in type, too late to introduce appropriate modifications. In order to preserve their (approximate) completeness this supplement is offered. Additional information, but no change in his previous decisions, is provided by Donk on *Agaricus* (p. 149), *Dictyolus* (p. 152), *Hypochnus* (p. 152), *Paxillus* (p. 154), *Podoscypha* (p. 154), and *Tomentella* (p. 158), which are not discussed here further. A recent paper by Bisby (1949) contains in brief notes much useful information on fungus nomenclature, and it is similarly referred to here in several places. While the present notes were in press an additional nomenclatorial paper by Donk was received; in it Donk has anticipated a number of the conclusions herein presented. He also reports (Donk 1949c) the discovery of two additional authors, Staude and Wünsche, who, in 1857 and 1877 respectively, preceded Quélet in the transformation of Friesian infrageneric groups into genera. Where these most recent conclusions have some bearing on nomina conservanda proposita they are referred to in these notes.

In the notes that follow the earlier discussion is not repeated, nor are the references appended to it. "Recommendation" means the recommendation of the writer; author- and literature-citations for proposals previously discussed will be found on the pages cited under "Rogers 1949." Again the principle has been followed that cases that can be dealt with by the Rules should not be made the subject of exceptions (i.e., conservation), and that the shorter the list of conserved names, the better.

I. NOMINA CONSERVANDA

ACROTHECIUM vs. CORDANA and CACUMISPORIUM — Bisby 1949 pp. 4, 11; Rogers 1949 p. 428.

Bisby writes: "*Cacumisporium* evidently should not be rejected."

ALEURODISCUS vs. CYPHELLA — Donk 1949 p. 88; Rogers 1949 p. 433.

Donk retains his earlier proposal, changing only the citation for *Aleurodiscus*. His former citation was adequately supported (Donk 1941; Rogers & Jackson, Farlowia **1**:269), and the present writer's recommendation stands.

AMANITOPSIS ROZE vs. VAGINATA NEES ex GRAY — Donk 1949 p. 113.

In this proposal the nomen rejiciendum is ascribed to "S. F. Gray"; but since Gray ascribed it to "Esenbeck," it should, under Art. 48 and 49, when written in full be "Nees ex Gray." Since under the Rules Gray first published the name, any of his species is eligible as lectotype. Murrill designated *V. livida* and Singer & Smith (1946 p. 249) apparently concur. At least many of the combinations in *Vaginata* have already been published, and it seems doubtful that conservation of the newer name would "avoid disadvantageous changes in the nomenclature of genera." Since it is also far from certain that a genus distinct from *Amanita* will be maintained for these fungi, there is even less reason to attempt conservation. As in the earlier notes under *Volvaria* (q.v.), it is recommended that the proposal be rejected.

ASCHERSONIA vs. ASCHERSONIA — Bisby 1949 pp. 7, 8, 56; Rogers 1949 p. 434.

Bisby notes that *Underwoodina* OK. is at present the legitimate name for *Aschersonia* Mont.

AURICULARIA vs. AURICULARIA — Donk 1949 p. 89; Rogers 1949 p. 434.

Donk retains the substance of his earlier proposal but substitutes different citations for the nomen conservandum and n. rejiciendum. The recommendation stands.

It would be of interest to mycologists in general to learn the bases for Donk's reservation of judgment concerning the priority of Fries's Systema 1 to Gray's Natural Arrangement (p. 91, footnote 2). Fries's own assertion and the evidence of Hinrichs place the former no later than June 30, 1821. Gray's volumes themselves place the latter no earlier than Nov. 1, 1821. Surely such contemporary published evidence must be accepted where all contrary evidence is lacking.

CALOCERA vs. CORYNOIDES — Donk 1949 p. 114; Rogers 1949 p. 434.

Donk considers *C. cornea* the type of *Corynoides*; this selection would necessitate the conservation of *Calocera*. It is preferable to designate *C. fabarum* as lectotype, since this makes of *Corynoides* a nomen dubium, interfering with nothing; and this selection was made by Doty and the writer and published in 1948. The earlier discussion, according to which the present proposal is both unnecessary and impossible, stands.

CALODON vs. HYDNELLUM — Maire p. 35; Donk 1949 p. 151; Rogers 1949 p. 435.

The earlier recommendation, which agrees with Donk's, stands.

CANDIDA BERKHOUT, De schimmelgeslachten Monilia, Oidium, Oospora en Torula 41. 1923 — Type: *C. vulgaris* Berkh., l.c. p. 42 — vs. SYRINGOSPORA QUINQUAUD, Arch. Physiol. Norm. Path. **1**: 293. 1868.

The proposal has not yet been published (cf. A. & B. 1943 p. 47, 1945 p. 52), but was submitted to the Congress in multigraphed form by Dr. Rhoda Benham. Of the various names published for *Monilia* sensu medicorum non Pers. (Rogers 1949 p. 457) *Candida* is the only one now widely employed and the only one which seems to have any chance of acceptance by the non-mycological group who commonly deal with these fungi; *Syringospora* has no currency whatever. The genus is of considerable importance in human pathology and embraces a sufficient number of species (if they be such; at any rate, of specific names) that the conservation of *Candida* is abundantly justified.

C. vulgaris is the designated genotype. The fungi to which Berkhout gave that name were received by her as "*Monilia candida* Bon." Since she entertained some doubt whether they actually represented that species, since that doubt is amply justified, and since in any event there is no *M. candida* Bon., but only *M. candida* Pers., the name Berkhout gave to her material is here listed for the type rather than the dubious name under which she discussed that material; the basis for the genus is then Berkhout's description, figures, and (if still in existence) specimens.

Conservation of *Candida* automatically brings about the rejection of other names judged synonymous with it (Art. 21, Note 3). It is strongly recommended that the proposal be adopted.

CAPNODIUM MONT. vs. APIOSPORIUM FR., POLYCHAETON LÉV., and FUMAGO LÉV. — IR p. 122; IRA p. 39.

The chronology and citations for the nomina rejicienda are in need of correction. *Fumago* should be Pers., Mycol. Eur. **1**: 9. 1822; Léveillé had nothing to do with it. *Apiosporium* should be Kunze ex Fr., Syst. Orb. Veg. 156. 1825. *Polychaeton* should be (Pers.) Lév., Consid. Mycol. 125. 1846.

Apiosporium Salicis was designated by Kunze as the genotype (Myc. Hefte **1**: 8. 1817), and since it forms one of the three species treated in the genus by Fries in 1829 (Syst. Mycol. **3**(**1**): 255,6) when he first listed species, must be the type of *Apiosporium* Kunze ex Fr. "*Fumago Citri* Turp. (vix Pers.) . . . in *Mém. des Sav. étr. de l'Inst. de Fr.*, t. VI, p. 240" is the designated type of *Capnodium* (Ann. Sc. Nat. Bot. iii **11**: 233. 1849). Since Montagne noted on publishing the genus that Turpin had failed to see the fructification, it is not a happy choice; nevertheless, to alter an author's choice of type (especially when he was in possession of the facts) is beyond the competence of any later worker or of the author himself. *Fumago* as Persoon first set it forth consisted of seven species, of which the first two, "conformatione aequali," were not set apart in a subgenus, while the remaining five were assigned to " ** *Polychaeton*." It appears that the type should be chosen from the first two, *Polychaeton* having often been treated as a separate entity — (e.g., by Berkeley & Desmazières in Hort. Soc. Lond. Jour. **4**: 243–255. 1849); and since of these *F. Mali* is marked "An hujus generis?", the other, the first species

listed, *F. vagans*, should be the type. The type of *Polychaeton* is one of the five species assigned to *Fumago* ** *Polychaeton* by Persoon in 1822.

The writer has no proper basis for a recommendation for action on the proposal — nor has anyone else not acquainted with the characters of *Fumago vagans*, *Apiosporium Salicis*, *Fumago* [subg.] *Polychaeton*, and *Fumago Citri* sensu Turp. as represented in the specimens (or at least descriptions) of their authors. One would suppose that at least *Fumago* Pers. was a genus of Fungi Imperfecti (see notes on *F. vagans* under discussion of nomina confusa), and at least some of the others were Ascomycetes, in which event it would be neither profitable nor possible to reject the first in favor of the latter. The matter should be tabled until information on the types is available.

CERATOSTOMA SACC., Syll. Fung. **1**: 215. 1882 — Type: ? — vs. CERATOSTOMA FR. (Obs. Mycol. **2**: 337. 1818) ex Fr., Summ. Veg. Scand. 396. 1849. — Mason 1933 pp. 42, 44; Bisby 1949 p. 13.

In 1848 Fries wrote, "Quando *S[phaeriam] chionaeam* legebam, mox pro novi generis typo habui = Ceratostoma *Obs. Myc. II*"; *C. chioneum* (or, as spelled in 1849, *chionaeum*) was the only species of the genus illustrated in 1818 and the first listed in 1849; by Fries's own designation it is the genotype. Meanwhile Corda had published *Melanospora* (Icon. Fung. **1**: 24. 1837), with three species, of which one was *M. chionea*; he discussed the characters and raison d'être of the genus at some length in a note under that species, thereby strongly implying that it was what he had chiefly in mind in describing the genus (ergo, was the type). *Ceratostoma* Fr. is then presumably an obligate synonym of *Melanospora*.

Bisby writes, "*Ceratostoma* Sacc. is in need of conservation." He does not give a citation for the publication of this name; in Syll. **1**: 215 one finds "*Ceratostoma* Fr. S. Veg. Scand. p. 392, p. min. parte." Since Fries designated his own type, Saccardo's selection of a "minor part" (three species, all listed in Syll. **1**: 220 as "species incertae") to bear the name has no validity. As Bisby has elsewhere written "Karsten did not propose a genus *Craterella*" (p. 18), so here one must say "Saccardo did not propose a genus *Ceratostoma*." It is, however, legally possible to conserve "*Ceratostoma* Sacc." provided the modification of Art. 47 adopted at Amsterdam is retained at Stockholm. See the earlier discussion under *Phoma*, and Mycologia **41**: 215–219. It is here recommended that no such conservation be attempted.

CLAVARIA VS. CLAVARIA — Donk 1949 p. 115; Rogers 1949 p. 436.

The proposals cited are in agreement.

CLITOPILUS (FR.) KUMMER VS. PLEUROPUS PERS. EX GRAY — Maire p. 82; Donk 1949 pp. 117, 154; Rogers 1949 p. 464 (*Panus*); Donk 1949b pp. 301, 394.

The earlier recommendation was that *Panus* be conserved against *Pleuropus*; this arose out of Singer & Smith's selection of *Pleuropus fornicatus* as the lectotype. If that be a "binding" designation of the lectotype, as both Donk and the writer believe it is, the recommendation stands. If, however, as Donk would prefer, the designation of *Agaricus orcellus* by Earle and Murrill as the type of the pre-Friesian *Pleuropus* Roussel be held to fix the type for *Pleuropus* Pers. ex Gray also, the present proposal is in order.

It is in order, but by no means acceptable. As Donk points out, *Agaricus* trib. *Clitopilus* Fr. 1821 is far from coextensive with *Agaricus* trib. *Clitopilus* Fr. as used in 1838. As a matter of fact, of the 20 original species 8 were in 1838 included in the trib. *Pluteus*, 8 in the trib. *Entoloma*, and one each in trib. *Clitocybe*, *Eccilia*, and *Tricholoma*; only *A. angustus* Pers. ex Fr. remained in *Clitopilus*. Donk thence reasons that "*Agaricus* trib. *Clitopilus* Fr. . . . 1838" is a new name, a homonym of the 1821 name; in which case it is illegitimate, and so is *Clitopilus* (Fr.) Kummer if that be indirectly based on it. If that is so, there would be every reason for retaining *Pleuropus* sensu Murrill and Donk, which is stated to be a synonym of *Clitopilus* as currently used. If a genus has long possessed a legitimate name, and if many of the component species have had the combinations with that name published -- both true in this case — it seems scarcely a contribution to nomenclatorial stability to conserve against the legitimate name one which is not only invalid twice over but ambiguous (Art. 62). *Agaricus* trib. *Clitopilus* Fr. can of course be typified by almost any of its original species, but not, as proposed, by *Agaricus prunulus*, a species "not even mentioned at all among the members of |the tribe| of 1821 |and which| should, therefore, be disregarded" (Donk 1941 p. 180, in another connection). The obvious type is *Agaricus angustus* Pers. ex Fr. (*Clitopilus angustus* Kummer), the only original member of *Clitopilus* retained by Fries in his 1838 revision. It is hereby designated the lectotype of *Agaricus* trib. *Clitopilus* Fr., Syst. Mycol. **1**: 194. 1821, if that group be not already legitimately typified.

To return to *Pleuropus*: If Singer & Smith's typification stands, so does the earlier recommendation. If the typification of Earle & Murrill is judged applicable, it is strongly recommended that no conservation be attempted, and that Gray's name be allowed to prevail, as Murrill used it, for the genus later known as *Clitopilus*. In his most recent paper Donk (1949c) wishes to ascribe the name *Pleuropus* to "Gray" rather than "Pers. ex Gray." His argument, which depends on the typification of a section so named by Persoon in 1797, seems not to be in accord with the Rules or general usage. Art. 48 prescribes "Pers. ex Gray."

The authority cited for the proposed nomen conservandum necessitates consideration of a more general problem. Donk reports that it was his "fate" (perhaps "misfortune" would have been a better word) "to stumble on a popular booklet . . . in which Quélet was beaten by one year" in the self-imposed task of publishing genera for the earlier tribes and sub-

genera of *Agaricus*. The book is Kummer, Paul, Der Führer in die Pilzkunde. pp. [ii]+146. Luppe, Zerbst, 1871. Donk correctly points out that in Kummer's work "there are no references or author citations after the scientific names. Thus all new names . . . owe their valid publication to the accompanying [key] descriptions." Donk says (p. 87) ". . . all new names and recombinations . . ."; but it is evident that strictly there can be no recombinations. That is, since there are no author- or literature-references, every binomial in the genera of gill-fungi not published as such by an earlier author is, strictly, typified only by Kummer's description or (if he had any) specimens. Donk refers also (p. 119, 139) to basinyms for generic names of Kummer's. But that author wrote in his introduction (p. 12, footnote): "Es sei hierbei bemerkt, dass ich die grosse Gruppe der Blätterpilze . . . , welche von den meisten Autoren als die einige grosse Gattung *Agaricus* aufgeführt werden, aus guten Gründen in viele Gattungen zerlegt, ihnen aber meist die Namen gegeben habe, mit denen man herkömmlich die Gattung *Agaricus* zu gruppiren pflegte." Kummer does not then say or imply that is is raising the former inferior groups to generic rank; he explicitly claims that he himself "divided . . . the large group of the gill-fungi . . . into several genera" — to which, almost (he would lead one to believe) fortuitously, he "mostly gave the names by which it was customary to classify the genus *Agaricus*." There is, then, no formal or necessary correspondence between, for example, *Clitopilus* Kummer, Führer Pilzk. 23, and *Agaricus* trib. *Clitopilus* Fr. 1821, *Agaricus* [trib.] *Clitopilus* Fr. sensu Fr. 1838, or *Agaricus* [group] *Hyporhodius* [group] *Clitopilus* Fr. sensu Rabenh. 1844 — nor between *Clitopilus Prunulus* Kummer, Führer Pilzk. 97 and *Agaricus Prunulus* Pers. ex Fr. 1821 or *Clitopilus Prunulus* ("Scop.") ex Quél. 1872. Strictly, Kummer's names are at best taxonomic synonyms of names of other authors, and at worst earlier homonyms of well established and universally accepted generic names or binomials.

Donk writes (p. 86) ". . . little shines through from [Kummer's] field experience and . . . his mycological library must have consisted of hardly more than one work: L. Rabenhorst 'Deutschlands Kryptogamen-Flora. Pilze.' [1.Aufl.] 1844. . . . a compilation based in the first place on Fries' Epicrisis. . . . It can be deduced that Kummer raised to generic rank — modified or not — Rabenhorst's tribus, which in turn are those — modified or not — of Fries' of 1838." Donk's deductions are confirmed by comparison of the works in question. In his key Kummer has 42 generic names in the gill-fungi. Of these four are used for genera in Rabenhorst, and of the remaining 38 only three are not exact duplicates of the latter's infra-generic names: *Leucopus* and *Rhaphanazon*, both new genera, and *Galorrheus*, which differs from the name in Rabenhorst by one *r*. The two new genera are described in the key on p. 22; but on p. 85, before any species have been assigned to them, are "combined as the following single genus: *Cortinarius*." Kummer's advance over Rabenhorst then consists, so far as these names are concerned, in a) the difference in rank attributed

to them and b) the letter *r*. Of Kummer's generic names six are given to genera by Fries in the Epicrisis; 32 are there employed for infrageneric groups (rank unspecified); one (*Galorrheus*) stems from the Syst. Myc. and was changed to *Lactarius* in the Epicrisis; and one (*Rhymovis*) is Persoonian; *Cortinarius*, for which Kummer discarded his two new genera, makes a seventh Friesian generic name adopted by Kummer. As to species only one seems to have been intended as new: "Da er bisher nirgends von den Autoren angegeben ist, habe ich Ihn *R*[*ussula*] *narcotica* benannt" (p. 100). It may then be inferred that all other species had, in Kummer's opinion, been somewhere "indicated by the authors."

As Donk implies, the Kummer book is taxonomically worthless. The long list of new names is apt, however, to prove an embarrassment to students of the agarics. Since (except for assigned rank) it is abundantly clear that whatever his own evaluation of his work Kummer took over Rabenhorst's classification lock, stock, and barrel, and since he implied that all of his species but the one were those of earlier authors, it is strongly recommended that the difficulties presented by the existence of this book be avoided as they are in Donk's paper: All of Kummer's names not explicitly new are to be associated with names of genera or of infrageneric groups in Rabenhorst, Deutschlands Kryptogamen-Flora. 1 Bd. 1844. The precedent for such "association" exists in the last paragraph of Art. 20. For such a procedure the semblance, at least, of legality can be provided. Whatever Kummer says of his work, his innovations present little evidence of derivation from study of the fungi, and devastating evidence of derivation from Rabenhorst's book. It is therefore submitted that for many names (and can be stipulated that for all names except the two discarded new genera and the single new *Russula*) the type is not "a specimen or preparation" (Art. 18) but "a description . . . given by a previous author" — namely, Rabenhorst.

COLLYBIA (FR.) KUMMER VS. GYMNOPUS PERS. EX GRAY — Donk 1949 p. 120; Rogers 1949 p. 436; Donk 1949c pp. 322, 394.

The proposal embodies a typification of *Gymnopus* different from that earlier published by Singer & Smith (1946 p. 249). There seems to be no obstacle to the earlier typification; and unless it is discredited the present proposal is unnecessary. It should be rejected.

See notes on Kummer under *Clitopilus*. The existence in the Epicrisis of two collybias — 1) *Marasmius* [trib.] *Collybia* Fr., Epicr. 373, referred by Fries to "S. Orb. V. **1**: p. 73" (actually pp. 67 and 71), and there referred to *Agaricus* trib. *Collybia* Fr., "*S. M. I.* p. 129" and 2) *Agaricus* [trib.] *Collybia* Fr., Epicr. 81, without reference — confuses the problem of synonymy and typification. Are the two nomenclatorially distinct? and if so, which constitutes the basis of Rabenhorst's and Kummer's *Collybia*? *Collybia* in Kummer embraces 25 species of *Agaricus* [trib.] *Collybia* 1838 and 7 of *Marasmius* [trib.] *Collybia* 1838. Both the lectotype proposed by Singer & Smith (p. 260) and that of Donk (1949 p. 123) are members

of *Agaricus* [trib.] *Collybia* Fr. 1821. If Fries's 1838 group of that name is the same as the 1821 tribe, *A. dryophilus* is not eligible as type; since it is not an original member thereof; if it is not the same, its name is a later homonym and the group is of no nomenclatorial consequence. Donk's choice, *A. tuberosus* Bull. ex Fr., may well be accepted.

In his latest paper Donk writes the nom. cons. prop. "*Collybia* (Fr.) Staude, Schwämme Mitteldeutschl. xxviii, 119. 1857." The page citations and quoted material are correct also for an issue or edition at hand dated 1858, which may be identical except for the title-page. Unlike Kummer (for whose work see the discussion under *Clitopilus*), Staude explicitly states (p. xxv, under Agaricini), "Die folgenden Gattungen und Untergattungen sind sämmtlich nach Fries. Vergl. Systema mycologicum etc.," and it might therefore be strictly correct to write the genera "(Fries) Staude." An anomaly should, however, be noted: that Staude lists all species under "G. [= Gattung] *Collybia*" with binomials in "*Ag.*" [= *Agaricus*], a treatment that can be held to invalidate his generic name under Art. 37 as amended at Amsterdam, since it "is not validly published unless . . . definitely accepted by the author." It is submitted that Staude although referring to *Collybia* as a G[attung] did not definitely accept it as a genus, since he continued to refer species under it to *Agaricus*, thereby implying that it was only a subgenus or section; and that he therefore did not validly publish the genus *Collybia*. Since Donk (1949c p. 317) has only reluctantly drawn the attention of mycologists to Staude's forgotten popular work, it is to be hoped that he and other taxonomists will concur in this decision.

CONOCYBE vs. RADDETES, etc. — Donk 1949 p. 93; Rogers 1949 p. 437.

Donk's later decision is that "the proposal might better be suspended." If, as Donk now suggests, *Raddetes* can be considered a nomen dubium, this is the preferable disposition; otherwise the 1949 recommendation stands.

CORTICIUM vs. PHLEBIA and RICNOPHORA — Donk 1949 pp. 93, 140; Rogers 1949 p. 438.

The proposal has been amended by adding *Corticium* Gray, *Athelia* Pers., and *Hyphoderma* Wallr. to the nomina rejicienda. In 1944 I wrote (Mycologia **36**: 78), "It would be possible at this time to fix the application of Persoon's generic name by the formal designation of a lectotype for *Athelia*. It seems advisable, however, to refrain from making such a decision until the actual need arises for a generic name for some other species of that group." Donk reports that the type specimen of *Athelia epiphylla* Pers. is the fungus commonly known as *Corticium centrifugum* (Lév.) Bres., and designates *A. epiphylla* as the lectotype of Persoon's genus. Now the name *C. centrifugum* is untenable for the fungus in question on several grounds (Rogers & Jackson, Farlowia **1**: 286–288), and there seems to be no currently accepted generic name available for it and

related forms. Donk has thus done a service to mycologists in supplying, by his typification, both a generic and a specific name for a fungus in need of both, and his decision should be gratefully accepted. It would be a pity to minimize it by enumerating *Athelia* among the nomina rejicienda, the more so that such enumeration would not, as he agrees, in any degree affect the status of *Athelia* for those who (like Donk and the writer) do not consider its type congeneric with the type of *Corticium*. It is therefore here recommended that *Athelia* be not listed among the rejicienda.

Donk similarly designates *H. spiculosum* as the lectotype of *Hyphoderma*. That species is a synonym of *Peniophora aspera* (Rogers & Jackson, Farlowia **1**: 282). Since *Hyphoderma* may be considered a later synonym of *Corticium* Gray and does not conflict with *Corticium* in the current sense, there is no occasion here for its formal rejection; since *P. aspera* and its relatives may well be in need of a generic name, there is every reason for not rejecting it. Therefore it is here recommended that it not be included among the nomina rejicienda.

The writer's 1949 recommendation stands.

CORTINARIUS vs. CORTINARIA — Donk 1949 p. 124; Rogers 1949 p. 440.

Donk and the writer agree that *Cortinarius* and *Cortinaria* are "variants of each other" — i.e., different spellings of the same name — but Donk would nevertheless "conserve the variant *spelling*." There is no provision in the Rules for this, and it seems in any case entirely pointless; the earlier recommendation stands.

CRATERELLUS PERS. vs. CRATERELLA GRAY — Donk 1949 p. 125, 154; Bisby 1949 p. 18; Rogers 1949 p. 471 (*Podoscypha*).

Since Gray wrote of "*Craterella* Pers.," in making a complete citation there is no option under the Rules but to cite the genus as "Pers. ex Gray." Donk correctly points out that *Cratarellus* Pers., Mycol. Eur. **2**: 4. 1825, is neither the same genus nor a homonym: "there is perhaps no necessity to conserve [*Cratarellus*]." It is recommended that the proposal be rejected.

Since the valid (Art. 70) spelling of *Cratarellus* (typified by *C. cornucopioides*) serves to differentiate it from *Craterella*, and since there is no provision in the Rules for conservation of a special orthography, it is urged that Persoon's spelling be left unaltered.

As Bisby notes (of the proposal in IR), "Karsten did not propose a genus *Craterella*"; what one finds in Bidr. Känned. Finl. Nat. Folk **37** (= Hattsv. **2**): 121 is "*Craterella* Pers." Although in the earlier recommendation it was indicated that Karsten's use of the name is illegitimate, the authorship was incorrectly stated.

CYSTOPUS BARY, Ann. Sci. Nat. Bot. iv **20**: 31. 1863 — Type: *C. candidus* Bary, l.c. p. 130 — *vs.* CYSTOPUS BLUME, Fl. Jav. Nov. Ser. 69. 1858. — Rogers 1949 p. 432 (*Albugo*); Shaw 1950.

The author of this proposal did not supply the typification nor citations of the names in question; presumably he had in mind those here given. De Bary's footnote on p. 31 is cited, rather than the treatment in his "Synopsis" (p. 129), since in the latter place De Bary did not find it necessary to mention oospores in describing the genus.

It is Shaw's contention that "the name 'given' to the perfect state . . . must be 'accompanied by a description . . . or by a reference to a previously and effectively published description' of that state"; and that "in the Oomycetes . . . the oogonium and its contents must be described." The implication is that the description, rather than the material described, determines the application of a name. The effect of this principle is to invalidate names published with inadequate descriptions. What in general constitutes a description of the perfect state is not specified, and must of course be determined for each name and by each student independently — without reference (under Shaw's interpretation) to the type specimen.

On this basis Shaw considers *Albugo* a "nomen provisorium"; and since the second name for the genus, *Cystopus* Lév., is a later homonym, he proposes its conservation. *Cystopus* Blume being the name of a genus of spermatophytes, adoption of the proposal would require the concurrence of the Special Committee for Phanerogams and Ferns. The present writer's earlier conclusion, that *Albugo* is not rejected by the existing Rules, stands, and it is here recommended that the proposal be rejected.

DICHAENA Fr., Syst. Orb. Veg. 108. 1825. — Type: *Hysterina macularis* Ach. ex Gray, Nat. Arr. **1**: 505. 1821 — vs. HETEROGRAPHA FÉE, Meth. Lichenograph. xxxi. 1824. — Bisby 1949 p. 29.

Fries designated *H. macularis* as the type of his genus; the citation here given for that species is the earliest that appears after January 1, 1821. In 1828 he reduced that name to synonymy under *Hysterium* (*Dichaena*) *rugosum* (L.) ex Fr., El. **2**: 141, formally rejecting his genus *Dichaena* (near the middle of p. 142), and in the same paragraph (last line of p. 142) implying that it would nevertheless probably be used. In 1849 he again recognized *Dichaena*, again stating, "Typus generis est *Opegrapha macularis Ach.*," although listing that species under the name *D. rugosa* (Summ. Veg. Scand. 402.). In 1828 and 1849 *faginea* and *quercina* are given as infraspecific entities under *H. rugosum* or *D. rugosa*.

Heterographa was published the year before; according to Fée, the genus "est fondé sur deux opegraphes, *Opegrapha faginea* et *quercina*, de de Candolle, réunies en une seule espèce par Acharius, sous le nom de *macularis*." The name is therefore an obligate synonym of *Dichaena*. Bisby writes, "Presumably *Dichaena* should be conserved, if necessary." Whether the genus is of sufficient importance to make conservation necessary is doubtful. Bisby, who presents the status of the genus in Brit. Mycol. Soc. Trans. **25**: 135–6. 1941, lists two species from Great Britain; Ainsworth & Bisby 1945 p. 94 note "2 or 3."

ERIOSPORA BERK. & BR., ERIOSPORA HOCHST. EX A. RICH., and ERISPORA PAT. — Bisby 1949 p. 24.

In Kew Bul. Mis. Inf. **1935**: 83 Dandy proposed the conservation of *Eriospora* Hochst. [1852] (for date see Soc. Bot. France Bul. **1**: 383. 1854), a name of a genus of Cyperaceae; the adoption of this proposal would under Art. 21, Note 4, automatically bring about the rejection of *Eriospora* Berk. & Br., Ann. Mag. Nat. Hist. ii **5**: 455. 1850, a name in use for fungi. Since Dandy withdrew the proposal for this very reason (Zesde Int. Bot. Congr. Proc. **1**: 359), the name *Eriospora* Berk. & Br. is not endangered. *Erispora* (not *Eriospora*) Pat., Soc. Mycol. France Bul. **38**: 84. 1922, is a name of obscure derivation; since the genus is "caractérisé . . . par des asques myriospores et par des spores brunes et uniseptées," it cannot mean "wooly-spored"; probably the prefix is ἐρι-, "much." In any event, Patouillard's name differs in spelling, in pronounciation, and in derivation, and is therefore not a homonym.

FLAMMULA VS. FLAMMULA — Donk 1949 p. 95; Rogers 1949 p. 443.

Donk's earlier proposal has been revised to list the nomen conservandum as *Flammula* (Fr.) Kummer 1871 and the type as *A. flavidus*. The proposed typification is acceptable. With substitution being made where appropriate of "Kummer" for "Quélet," the earlier discussion may stand.

GALERA VS. GALERA — Donk 1949 p. 96; Rogers 1949 p. 444.

Donk's former proposal is revised to make the nomen conservandum *Galera* (Fr.) Kummer 1871. He quotes a considerable body of opinion and evidence tending to show that *Galerula* Karst. is a nomen dubium, and supports *Agaricus hypnorum* Batsch ex Fr. as the lectotype of *Galera* (Fr.). It was earlier recommended that the decision, a taxonomic rather than a nomenclatorial one, should be left to the experts. It seems that in the light of his further evidence they will wish to support Donk's proposal.

GAUTIERIA VITT., Monogr. Tuber. 25. 1831 — Type: *G. morchelliformis* Vitt. — vs. GAUTIERA RAF., Med. Fl. **1**: 202. 1828.

Rafinesque's name, proposed for *Gaultheria* [Kalm ex Linn., Gen. Pl. 5 ed. 187] was superfluous and hence illegitimate (Art. 60 as modified at Amsterdam; Amst. Proc. **1**: 354; IRB p. 90; IRA p. 22) when published; nevertheless, *Gautieria* is an orthographic variant of Rafinesque's name (see Art. 70, "Examples of orthographic variants") and to be rejected under Art. 61 and Note. *Gautieria* is a well-known genus of some size (there are fifteen species listed by Zeller & Dodge in Mo. Bot. Gard. Ann. **21**: 692–705. 1934) which has never been known by its legitimate name *Usleria* Nieuwl., Am. Midl. Nat. **4**: 378. 1916. It originally included two species, of which Zeller & Dodge have designated the first and most minutely described, *G. morchelliformis* (for "*morchellaeformis*") as lectotype. It is therefore hereby proposed that *Gautieria* be conserved against *Gautiera*.

It appears that *Gautieria* (for Joseph Gautier) and *Gaultheria* (for Jean François Gaultier) are "different" under Art. 70 Note 3, and therefore the conservation of the former need not interfere with the continued use of the latter.

GOMPHUS vs. GOMPHORA — Donk 1949 p. 98; Rogers 1949 p. 445.

Withdrawn by Donk for the same reasons listed by the present writer.

GUEPINIA vs. GUEPINIA — Rogers 1949 p. 445; Nannfeldt 1947 p. 334.

Nannfeldt rejects this proposal, as do its author and the earlier recommendation.

GYROMITRA FR. vs. GYROCEPHALUS PERS. — Donk 1949b; Rogers 1949 p. 445. (*Guepinia*)

Donk notes that what seems to be the type of Persoon's genus, *Helvella sinuosa* Brond., is a *Gyromitra*, and proposes the conservation of that later name. *Gyromitra* is a relatively small genus, possibly insufficiently distinct from *Helvella*, and ordinarily would not be worth saving. However, the alternative, *Gyrocephalus*, has been so much used by the deluded followers of Brefeld in place of the legitimate *Phlogiotis* that its correct use would occasion endless confusion. It is therefore recommended that the proposal be adopted.

HERICIUM vs. HERICIUM — Donk 1949 p. 98; Rogers 1949 p. 447.

Withdrawn by its author for the same reasons given in the writer's earlier discussion.

HEXAGONA vs. SCENIDIUM — Rogers 1949 p. 447.

Hexagona is listed under Art. 70 as "an unintentional orthographic error for *Hexagonia*"; since Fries's spelling is consistent in Syst. Mycol. **1**: 344, Fl. Scan. 339, Gen. Hym. 11, Epicr. 496, Summ. Veg. Scand. 324, K. Vet. Ak. Handl. **1848**: 136 (Fung. Natal.), R. Soc. Sc. Upsala Nova Acta iii **1**: 100 (Nov. Symb.), and Hym. Eur. 589 — i.e., throughout his works — it appears that "unintentional" is gratuitous and unproved. Since Fries was free (under the current Rules) to adopt, discard, or alter any name he chose, there seems no reason to reject the form which he employed.

HYDROCYBE (FR.) WÜNSCHE vs. LEUCOPUS KUMMER — Donk 1949c pp. 361, 362, 365, 394.

As noted under *Clitopilus* (q.v.), Kummer separated *Leucopus* and *Rhaphanazon* in his key, but before treating any species "combined them as the . . . single genus *Cortinarius*." It is submitted that the generic name *Leucopus* was not "definitely accepted by the author" (Art. 37) and was not validly published. The proposal is therefore unnecessary, and its rejection is recommended.

HYMENOCHAETE vs. STEREUM and HYMENOCHAETA — Donk 1949 p. 98; Rogers 1949 p. 450.

Donk typifies *Stereum* by *Thelephora hirsuta*, as does the present writer, and deletes that genus from the list of rejicienda on the same grounds. The earlier opinion, that "*Hymenochaete*" Beauv. ex Nees is an inadvertent misspelling of *Hymenochaeta* and does not interfere with the use of *Hymenochaete* Lév., stands, as does the consequent recommendation.

HYPOLYSSUS vs. PERONA and CARIPIA — Rogers 1949 p. 451.

In the earlier notes it was stated that *Podostrombium* Kunze is the correct name for *Hypolyssus* sensu Berk. non Pers. In spite of extensive search no description has been found among G. Kunze's works. This is odd, because the name and the character of the genus seem to have been known to a number of the author's contemporaries; and Fries (Summ. Veg. Scand. 484) mentions a "schedula" of Kunze's. As early as 1828 Reichenbach, Conspect. 8, listed *Podostrombium* as "Fung. guian."

Since Léveillé's brief publication of *Podostrombium* in 1846 includes all the data supplied by O. Kuntze in his more prolix later publication of *Caripia*, there seems no basis but captiousness for rejecting the one and accepting the other. Anyone whose conscience still refuses the 1846 publication will cite *Podostrombium* Kunze ex Wittstein, Etym.-bot. Handwörterb. 711. 1856, where appears the statement "das Peridium is kreiselförmig und gestielt" — a meager, but legal, description.

It seems highly probable, although the material is not at hand for confirmation, that Kunze's name was proposed for one of Weigelt's exsiccati from Surinam. It is therefore worthy of note that Weigelt collected with Hering in Surinam, and, since much of Hering's material was sent to America and his fungi fell into Schweinitz's hands, that *Heringia* (for which see the earlier notes) and *Podostrombium* were based on the same collections. (Cf. Torrey Bot. Cl. Mem. **16**: 250. 1921.)

LACHNOCLADIUM vs. ERIOCLADUS — Singer 1944 p. 553; Donk 1949 p. 100; Rogers 1949 p. 453.

Revised by the author to list *Lachnocladium* Lév. as published in "Consid. Mycol. 1846" (the page is 108). Donk (1941) has made out a good case for *Clavaria furcellata* Fr. as the type, and Singer (a reference omitted from the earlier list of references) and Doty (p. 131) an equally good one for *E. brasiliensis* Lév.; Doty implies that *C. furcellata* is a nomen dubium. In the matter of conservation the 1949 recommendation stands.

MARASMIUS vs. MICROMPHALE — Donk 1949 p. 128; Rogers 1949 p. 454.

Although presented as a "new proposal," Donk's decision agrees with the earlier proposal of Singer & Smith and with the writer's recommendation.

MONILIA vs. MONILIA — Mason 1933 p. 11; Rogers 1949 p. 457.

Mason typifies *Monilia* by *M. cinerea* Bon. — a fact not noted in the earlier discussion. The recommendation stands.

MONOTOSPORA vs. MONOTOSPORA — Diehl p. 279; Rogers 1949 p. 459.

Diehl's comment is pertinent here. The recommendation stands.

MYCENA (PERS.) EX GRAY and PRUNULUS GRAY — Donk 1949 p. 85.

Donk notes that he regards the two names as synonyms, and elects under Art. 56 to retain the former. No proposal for conservation is offered or required.

MYCOLEPTODON vs. ODONTIA — Donk 1949 p. 100; Rogers 1949 p. 460.

Withdrawn by the author, for reasons similar to those advanced against the proposal by the present writer.

NUMMULARIA vs. BISCOGNIAUXIA — Bisby 1949 pp. 33, 40; Rogers 1949 p. 462.

In the writer's earlier discussion it was suggested that species now included in *Nummularia* Tul. non Trag. ex Gray might be "left without a generic name." Bisby lists two names published as substitutes for *Nummularia* Tul. — *Kommamyce* Nieuwl., Am. Midl. Naturalist **4**: 375. 1916, and *Numulariola* House, N. Y. State Mus. Bul. **266**: 49. 1925. The recommendation stands.

OMPHALINA QUÉL. vs. PERONA PERS. — Donk 1949 p. 131; Rogers 1949 p. 451 (*Hypolyssus*); Donk 1949c p. 326.

Singer & Smith (1946 p. 250) designated *O. adusta* (Pers. ex Fr.) Gray as the lectotype of *Omphalia* (Pers.) ex Gray. Their choice makes *Omphalia* a synonym of *Russula* Pers. ex Gray, and of these two synonyms of the same date they chose to retain *Russula* — a binding decision under Art. 56. It appears that their typification is binding also; Donk has chosen a different type, *Agaricus tardus*, from considerations of the pre-Friesian history of the name. But whereas a pre-Friesian typification may provide a cogent indication of the type species — as for *Phoma* Fr. (1819) ex Fr. (1823), for which see the writer's earlier notes — it cannot do more; and any of the subordinate groups included in the first legitimate publication is, other things being equal, eligible. The question whether *Omphalia* is a later homonym of *Omphalea* L. is one not resolved by the present Rules (see earlier notes under *Cyttaria*).

Omphalia (Fr.) Kummer is a later homonym of Gray's genus; if the citation in parentheses of Fries's name is justified, it must, directly or ultimately, be based on *Agaricus* Trib. *Omphalia* (Pers.) ex Fr., Syst. Mycol. **1**: 162. Of this tribe the type, designated by Donk, is *A. cyathiformis* Pers. ex Fr.; this species Fries in 1838 assigned to *Agaricus* V. *Clitocybe*. But whatever species Fries may have included in or excluded

from the infrageneric group *Omphalia* in 1825, 1838, and 1874, its type is the same *A. cyathiformis*; and if there is a genus *Omphalia* (Fr.) Kummer (see notes under *Clitopilus*) its type is the same. That is implied by the type concept.

But whatever may be inferred concerning Quélet's possible motives in publishing the genus *Omphalina* in Ench. Fung. 42. 1886, he did not, as Donk notes, cite Fries (nor Kummer) in so doing. Strictly, then, *Omphalina* is not a nom. nov. but a gen. nov., and can be typified without reference to *Omphalia*. It should be noted in this connection that *A. cyathiformis*, Donk's lectotype for *Agaricus* trib. *Omphalia* Fr., is retained by Quélet in the genus *Omphalia* (Ench. 24). Murrill (N. A. F. 344. 1916) designated *O. hydrogramma* (Fr.) Quél. as the type of *Omphalina*.

Donk has now (1949c) withdrawn this proposal on the ground that *Perona* is already rejected as a later homonym of *Peronia* Laroche in Redouté, Les Liliacées **6**: 342. 1812 (Scitamin.). But the two names are not identical in spelling nor pronunciation; *Peronia* is named for Franz Peron and *Perona* quite surely derived from περονη, a pin; and there is no danger whatever of confusion between Persoon's fungus genus and the long-abandoned angiosperm name. Therefore the two are not, it is submitted, homonyms under Art 70. See earlier notes under *Cyttaria*.

The synonymy of *Perona* with *Omphalina* must be regarded as not proved; at least, no record is at hand of the assignment of a species of either to the other. It seems at least equally possible that *Perona* will be found to be a synonym of *Helotium* when the latter name is correctly typified. It is recommended that the proposal be rejected.

As earlier indicated, there is no *Perona* Fr.

PACTILIA FR. vs. ACHITONIUM G. KUNZE ex O. KUNTZE — IR p. 126; IRA p. 41; Bisby 1949 p. 3.

Pactilia was described by Fries in Fl. Scan. 365 (not 363) 1835; the designated type, also described l.c., is *P. mycophila*. Fries later, in Summ. Veg. Scand. 472. 1849, cited Montagne's description and figure of *P. mycophila* (under the name *Tubercularia mycophila* Mont. & Fr.) published in Ann. Sc. Nat. Bot. ii **6:** 29. 1836; ibid. vol. 5 pl. 13 fig. 1. 1836; Fries also there listed as synonyms *Leucosporium* Corda in Sturm, Deutschl. Fl. III Abt. 3 Bändchen 13 Heft: 67. pl. 34. 1833, whose monotype, *L. vesiculiferum*, he renamed *Pactilia leucosporia*, and the name which Corda later substituted for the same genus, *Phymatostroma* Corda, Icon. Fung. **1:** 5. pl. 1, fig. 82, 83. 1837, with two additional species.

Achitonium Kunze ex Fries, Syst. Mycol. **3:** 470. 1832, is briefly described in a footnote, and again at the foot of p. [3] of the index, where *A. acicola* is given as its single species; it seems to be validly published. The genus was listed and *A. acicola* described by Sprengel in Linn. Syst. Veg. 16 ed. **4**(1): 580. 1827; the genus was again characterized by Fries in Fl. Scan. 367. 1835, and in Summ. Veg. Scand. 481. 1849 the single species *A. acicola* was again attributed to it.

There seem then to be four names available for the genus, in which Saccardo enumerates seven described species, and which Ainsworth & Bisby (1945 p. 225) judge to embrace "2 or 3" good ones. It appears then to be neither large nor of any great importance. The proposed lectotype is not eligible. It is recommended that the proposal be rejected.

PANAEOLUS (FR.) QUÉL. vs. COPRINARIUS (FR.) KUMMER — Donk 1949 p. 138.

Agaricus trib. *Coprinarius* Fr., Syst. Mycol. **1**: 300, embraced 18 species, one of which must be its type. Donk selects *A. papilionaceus* Bull. ex Fr. *A. campanulatus* Bull. ex Fr. is not eligible, since it was published (l.c. p. 295) as a member of trib. *Psilocybe* (in Epicr. 236 Fries published for it the synonym *A. ovalis*); there is of course no other legitimate *A. campanulatus*. *A. campanulatus* L. ex Fr., Epicr. 236, may be the type of *Agaricus* ser. *Coprinarius* [trib.] *Panaeolus* Fr., Epicr. 234, as Donk says, but certainly cannot be called by that binomial; according to Fries (p. 236) it is *A. papilionaceus* Bull. ex Fr., Syst. Mycol. **1**: 301. It is submitted that the lectotype for both names should be *A. papilionaceus* Bull. ex Fr. 1821, a name in turn typified by the "better part" of Bull. pl. 561 fig. II — i.e., as indicated by Fries in 1838, fig. II L.

There seem to be no obstacles to conservation of *Panaeolus*, and with the suggested alterations in naming of the type (but not in the fungus in question) adoption of the proposal is recommended.

PAXILLUS vs. RHYMOVIS — Maire 1937 p. 48; Rogers 1949 p. 465.

Maire's note should have been cited here; it does not alter the proposal nor the recommendation.

PENIOPHORA COOKE vs. CORTICIUM GRAY and HYPHODERMA WALLR. — Donk 1949 p. 140; Rogers 1949 p. 438 (*Corticium*).

Hyphoderma as typified by Donk, by *H. spiculosum* (= *Peniophora aspera* (Pers.) R. & J. = *P. setigera* (Fr.) H. & L.), is not necessarily synonymous with *Peniophora* as typified by *P. Quercina* (Pers. ex Fr.) Cke. (see discussion in these and the earlier notes under *Corticium*), even though, ad int., "the common tendency . . . is to admit a genus, universally called *Peniophora*, comprising both." The effect of overly zealous conservation here, as in many other cases, is merely to imply synonymy which actually is false; it cannot prevent the use of the nomen rejiciendum by those who do not regard the names as synonymous. The earlier recommendation stands.

PHELLINUS vs. PORIA — Donk 1949 p. 101; Rogers 1949 p. 466.

Withdrawn by the author on grounds presented with the former recommendation.

PHOLIOTA (FR.) KUMMER vs. DERMINUS (FR.) STAUDE — Donk 1949c pp. 324, 334, 394.

The remarks regarding Staude's work inserted under *Collybia* (q. v.) apply equally to *Derminus*. Since the latter name is held to be invalid under Art. 37, the proposal is unnecessary and should be rejected.

PISOMYXA CORDA vs. BRYOCLADIUM KUNZE — IR p. 122; IRA p. 41.

The genotype of *Pisomyxa* is *P. racodioides*, not "*rhacodioides*."

The nom. rejic. is listed (IR) as having appeared in "Flora (1830) 207"; there is no such name at the place cited; nor does it appear on p. 270, as given by Saccardo. In Flora **13**: 132. 1830 appears a short description of "*Bryocladium maculans*. Kz." There is no "combined generic and specific description" as exemplified under Art. 43, and *Bryocladium* is therefore a nomen nudum and conservation of *Pisomyxa* unnecessary. The proposal should be rejected.

Authors of proposals for conservation will earn the gratitude of their colleagues by verifying the citation, or at least the existence, of names which they submit for consideration.

PLEUROTUS vs. PTEROPHYLLUS and CREPIDOPUS — Donk 1949 p. 101; Rogers 1949 p. 470.

Revised to list *Pleurotus* as (Fr.) Kummer 1871, and to include as nomina rejicienda *Crepidopus* (as in Singer & Smith 1946), *Resupinatus* Nees ex Gray, *Pterophyllus* Lév., and *Hohenbühelia* Schulzer. Donk's reasons for enumerating the additional names appear adequate, and the former recommendation for adoption is extended to these additional rejicienda.

POLYSTICTUS FR. vs. COLTRICIA GRAY and STRIGLIA GRAY — Cooke pp. 86, 96; Donk 1949 p. 142.

Donk discusses the various essays at typification of the heterogeneous *Polystictus*, and gives as his opinion that Karsten first restricted the genus to one of its components in 1879 and in effect typified it by *P. perennis*. He accepts this as valid typification, and there appears no reason to differ from this decision. For the "Stirps" so chosen by Karsten to typify the genus is "A. stirps Polysticti perennis," whose type must be *P. perennis* even though that extra-tropical species is not described in Fries's Novae Symbolae. For a group so typified the legitimate name is *Coltricia* Gray, and that name has long been used, by Murrill and others who have not been willing to treat polypores in Fries's few and heterogeneous groups. *Polystictus* has also been widely employed, but frequently not for *P. perennis* and its allies; rather it has usually been the name for all coriaceous polypores, species as different as *P. versicolor*, *P. Tulipiferae* (not "*tulipiferus*") *P. conchifer*, and *P. cinnabarinus*. To conserve the name for such brown, stipitate forms as *P. perennis* will not, then, "avoid disadvantageous changes in the nomenclature of genera" (Art. 21); *Coltricia* is much better established *for the group in question* than is *Polystic-*

tus. It is therefore recommended that the legitimate name be allowed to stand, with *Polystictus* as a synonym, and that the proposal be rejected.

There seems to be under the Rules no alternative to citing *Coltricia* as "Mich. ex Gray" — except under the general clause (Art. 48, 2nd par.) which in any case permits omission of the author not actually the publisher of the name.

PORIA vs. PHYSISPORUS and PORIA — Donk 1949 pp. 103, 155; Rogers 1949 p. 471.

Withdrawn by Donk, in recognition of the priority of *Poria* Pers. ex Gray; he designates as lectotype *P. medullaris* Gray. This is in agreement with the earlier recommendation, which stands.

PSATHYRA vs. PSATHYRA — Donk 1949c p. 339.

The proposal is amended by citing the nom. cons. as *Psathyra* (Fr.) Kummer 1871 and by designating as the type *Agaricus fibrillosus* Pers. ex Fr.; the changes appear necessary and acceptable.

PTERULA Fr. 1830 vs. PTERULA Fr. 1825 — Doty p. 133; Donk 1949 p. 145.

As Doty notes, Fries wrote in Syst. Mycol. **1**: 464, "*Clavaria penicillata* Bull. est typus novi generis (*Pterula*)"; he chose not to describe it at that time, having only dried specimens. On p. 496 he referred the same species to a "genus inquirendum." His formal description of the genus, in 1825, refers to the latter page; in that year he added a second species. In 1830 Fries again described the genus and its two species, adding a third, *P. subulata* Fr. In 1832 he reduced *Pterula* to infrageneric rank under *Anthina*, retaining the same species, but marking the designated type "*A.* (*Pterula*?) *penicillata*." There can be no doubt from his successive citations that there is only the one *Pterula*, nor that *P. penicillata* is its type. "*Pterula* Fr. 1830" is therefore a nonentity, and the proposal an impossibility. It should be rejected.

RAMARIA vs. CLADARIA — Donk 1949 p. 106; Rogers 1949 p. 473.

Modified by the author to include *Ramaria* Holmsk. ex Gray among the rejicienda. The original description of *Cladaria* had previously been accessible neither to Donk nor to the present writer. The pertinent portion of Ritgen's article follows: "ASTKEULENSCHWÄMME. *Merisma* (149). Die astigen Clavarien müssen abgetheilt werden von den einfachkeulenförmigen, welches unter dem Namen *Cladaria* geschehn kann (150–153). KEULENSCHWÄMME. *Clavaria* (154. 155). *Spatularia* (256). *Geoglossum* (157–159). *Leotia* (160)." Ritgen's sentence is somewhat obscure, but from his center-headings (here printed in capitals) and the Nees illustrations to which his numbers refer there can be no doubt that *Cladaria* was published for the branched species of *Clavaria*. Donk designates *Clav.*

cornicula!a (Nees's no. 152) as lectotype; but Doty (p. 126) had earlier selected *Clav. amethystina* (Nees's no. 151); no obstacles to Doty's selection appear. It seems that the citations of both authors need revision. The copy of the Marburg publication at hand does not have a title-page or table of contents for the second volume, which consists of a number of sections separately paged. The Ritgen article in question forms pp. [39]–98 of one such section, and its first leaf is conjugate with a leaf of the preceding article (also by Ritgen), which is dated, on its title-page, 1828. What follows in brackets is the result of inference, but the date and page are unquestionable; the correct citation is *Cladaria* Ritgen, [Gesell. Beförd. gesammt. Naturwiss. Marburg Schr. **2**(3):] 54. 1828.

In the matter of conservation Doty pp. 126, 128, 134 should be consulted. The earlier recommendation — for rejection — stands. Doty's lectotypes for *Cladaria* and *Ramaria* are acceptable and valid; there is no place for the substitution of others by a subsequent author. *Ramaria* has been used by more than one author but, as anyone can discover by examining recent general treatments of the Clavariaceae, has no real currency.

RHODOPHYLLUS vs. ACURTIS, étc. — Donk 1949 p. 156, 157 (*Entoloma*); Rogers 1949 p. 474; Smith 1950.

Donk corrects the proposal by substituting "Kummer 1871" for "Quélet," by citing *Claudopus* as "(W. G. Smith)" rather than "(Fr.)," and by adding to the rejicienda *Latzinaea* OK. He then rejects it on the grounds advanced for the earlier recommendation. Finally, he accepts the responsibility conferred by Art. 56, choosing *Entoloma* (Fr.) Kummer from among the earlier synonyms of *Rhodophyllus* as the valid name for the group. This is in accord with Singer & Smith's earlier typification. All of this, which is in agreement with the earlier recommendation, seems quite acceptable.

Smith remains of the opinion earlier expressed by Singer and by Singer & Smith that stability of names will be favored by conservation of *Rhodophyllus* against the five generally-accepted earlier genera of which it is composed. The matter is settled, however, by the existence of *Rhodophyllis* Kütz., Bot. Zeit. **5**: 23. 1847; *Rhodophyllus* cannot be conserved without displacing the earlier homonym (Art. 21, Note 4) in current use by algologists.

The foregoing leaves out of account Fries's curious name *ACurtis*. It was earlier stated that *Clavaria gigantea* Schw., a species based on the characteristic abortive carpophores of what is usually called *Clitopilus abortivus* B. & C., and the basis of the genus *ACurtis*, is an imperfect state. Smith seems to regard it as the "fruiting stage" of the fungus, and because of that, as the perfect state. The biological function of the *ACurtis* stage seems not to be known; but intergrades between it and the completely different basidium-bearing fructifications, if they exist, must be rare and abnormal, and its nearest analogue in other fungi would seem to be the bulbils of *Trechispora Brinkmanni* (cf. Biggs, Mycologia **29**: 696–697)

or the *Ptychogaster* stage of some polypores (except that these are both reproductive). Schweinitz's type as represented in the Farlow Herbarium is certainly sterile and without so much as a pileus. It might be noted that if the abortive structures in question were the perfect stage the fungus should be called not *Rhodophyllus abortivus* (B. & C.), as by Singer & Smith, nor *Clitopilus abortivus*, but *Rhodophyllus giganteus* (Schw.) or *Clitopilus giganteus*. The fact that neither name seems to be employed, even by such conscientious mycologists as the authors in question, is evidence that the structures are generally regarded as imperfect. Ergo, the name *ACurtis* does not conflict with *Clitopilus* — nor with *Entoloma* nor *Rhodophyllus*.

SCOPULARIA and SCOPULARIA — Rogers 1949 p. 476.

Scopularia Preuss, the later homonym, was long ago renamed *Lindavia* by Nieuwland, Am. Midl. Naturalist **4**: 385. 1916.

SEPTOBASIDIUM vs. GLENOSPORA and GAUSAPIA — Donk 1949 p. 108; Rogers 1949 p. 476.

An additional nomen rejiciendum is introduced — *Campylobasidium* Lagerh. ex Ludw. From Ludwig's characterization that name would be either a nomen dubium or a synonym of *Cystobasidium;* but because Patouillard cites it under *Septobasidium* it appears that Lagerheim's name (Lagerheim was a collaborator of Patouillard's) really belongs there. There being at hand no evidence on the relative dates of Patouillard's article and Ludwig's Lehrbuch (both dated 1892), it is recommended that this addition be incorporated in and adopted with the earlier proposal. Donk now accepts the typification of *Septobasidium* published by Martin. The earlier recommendation stands.

STEREUM vs. AURICULARIA and STEREUM — Donk 1949 p. 110; Rogers 1949 p. 480.

Withdrawn, for reasons given in the earlier recommendation.

TELAMONIA (FR.) WÜNSCHE vs. RAPHANAZON KUMMER — Donk 1949c pp. 361, 362, 364, 368, 394.

It is submitted that *Rhaphanazon*, like *Leucopus* (for which see the earlier paragraph under *Hydrocybe*), is invalid under Art. 37, and that the proposal is unnecessary and should be rejected.

TREMATOSTOMA vs. CLYPEOTHECIUM — Rogers 1949 p. 483; Nannfeldt 1947 p. 324.

Nannfeldt rejects the proposal, and points out that Petrak in Ann. Mycol. **27**: 401 united his *Clypeothecium* with *Exarmidium* Karst., Bidr. Känned. Finl. Nat. Folk **23**: 222. 1873 (which Clements & Shear accept as autonomous).

TREMELLA vs. TREMELLA and GYRARIA — Rogers 1949 p. 483.

Donk (1949 p. 87) considers *Gyraria* "impriorable." This decision arises out of his interpretation of Art. 20(f) — an interpretation which has much to commend it, but which does not accord with the Rules as understood by the present writer. The 1949 proposal stands.

TREMELLODON vs. HYDNOGLOEA — Donk 1949 p. 110; Rogers 1949 p. 483.

Pseudohydnum Karst. is added to the n. rejicienda proposita. The earlier recommendation stands.

TRICHOLOMA vs. TRICHOLOMA — Donk 1949 p. 110; Rogers 1949 p. 484; Donk 1949c p. 326.

Tricholoma is now cited as (Fr.) Kummer 1871, although in his most recent paper Donk states that the correct citation is "(Fr.) Staude, Schwämme Mitteldeutschl. xxviii. 125. 1857." What is said of Staude's work under *Collybia* applies here.

If the BMS selection of *T. rutilans* as the lectotype be regarded as the valid one (as it well may be, earlier choices having apparently been of species for one reason or another ineligible), *Tricholomopsis* Sing. would appear to be a nomen superfluum, illegitimate under Art. 60(1) as modified at Amsterdam (IRB p. 90; IRA p. 22). Otherwise, Donk's lectotype, *T. imbricatum*, should be accepted. The earlier recommendation stands.

VOLVARIA vs. VOLVARIA — Donk 1949 p. 112; Rogers 1949 p. 488.

Modified by the citation of the nomen conservandum as *Volvaria* (Fr.) Kummer 1871. Donk designates *Agaricus volvaceus* as the lectotype. The earlier recommendation was for rejection, on the ground that the name *Volvariopsis* had already been used for most of the species, and therefore conservation would not "avoid . . . changes." Donk now indicates the possibility that *Volvariella* Speg., Mus. Nac. Buenos Aires Anal. **6**: 118. 1899, may be a synonym and necessitate a whole new set of binomials. If in the judgment of students of agarics this synonymy is considered established, the present proposal should be adopted.

XEROCOMUS QUÉL. vs. VERSIPELLIS QUÉL. — Donk 1949 p. 147.

Snell (Mycologia **34**: 407) has proposed to get rid of the unwanted name *Versipellis* Quél., Enchir. 157. 1886, by considering it a nomen ambiguum. The Rule under which his proposal was offered is Art. 62: "A name . . . must be rejected if, owing to its use with different meanings, it becomes a permanent source of confusion or error." It is submitted that because of the wide use of *Boletus* II. *Derminus* 2. *Versipelles* Fr., Epicr. 423, the use of *Versipellis* for a segregate of the same genus but a different group of species would be "a permanent source of confusion or error." On this point Snell, Donk, and the writer are in agreement. The only question is whether *Versipelles* and *Versipellis* are "a name" — i.e., the same

name. It seems that as the plural and singular of the same word they incontestably are. It is therefore submitted that the case comes entirely under Art. 62, that Snell's rejection of Quélet's name is valid, and that in consequence the proposed conservation of *Xerocomus* is unnecessary. It is recommended that the proposal be rejected.

The case is quite different where a name is repeated for infrageneric groups within two or more genera — e.g., *Agaricus* VI. *Collybia* and *Marasmius* I. *Collybia*, in Epicr. 81, 373 — perhaps to suggest similarities. The latter practice is to be avoided (Rec. XI (c)), but past instances can be rejected only if conflict with some other Rule exists. The essence of the case against *Versipellis* is the likelihood of confusion.

The case is also different where the infrageneric name has less currency. With a little more mental agility the unwanted name *Pellicularia* Cke. (cf. Farlowia **1**: 95) might similarly have been disposed of, and the preferable *Botryobasidium* retained; the writer deeply regrets his failure to examine that possibility. But *Corticium* sect. *Pellicularia* Bourd. & Galz., Hym. Fr. 191, although well established, had little currency, and the probability of serious confusion seems slight. It is even less now that *Pellicularia* Cke. is well established and the section of *Corticium* has its own generic name *Athele* (for which see on a preceding page notes under *Corticium*).

II. NOMINA CONFUSA

The names are here listed as in the notes to which these are supplementary. Most were taken from Bisby's (1949) paper. In these lists, as in the earlier ones, where no question or objection is noted the cited evidence appears satisfactory, and it is recommended that the names be inserted in Appendix V of the Rules.

NOMINA SPECIFICA CONFUSA

ARCHILEGNIA LATVICA (APIN.) APIN., Hort. Bot. Univ. Latv. Acta **8**: 106. [1935 (Mar. 1)] (nom. nud.; cf. note under *Archilegnia*.) Cf. Sparrow, Aquat. Phycom. 514. 1943.

BYSSOTHECIUM CIRCINANS FUCKEL, Bot. Zeit. **19**: 251. 1861. Cf. Fuckel, Nassau. Ver. Naturk. Jahrb. **23**, **24**: 142 [1870].

CERATOCLADIUM CLAUTRIAVII PAT., Soc. Mycol. Fr. Bul. **14**: 196. 1898. Cf. *Xylocladium Clautriavii*.

CHAETASPIS STENOCHLAENAE SYD., Ann. Mycol. **15**: 219. 1917. Syn.: *Parmulina Stenochlaenae* (Syd.) Petr., Ann. Mycol. **27**: 377. 1929. Cf. Petrak, l.c.

COCCIDIOPHTHORA VARIABILIS SYD., Ann. Mycol. **11**: 263. 1913. Cf. Hara, Bot. Mag. Tokyo **28**: 339, 350. 1914; Petch, Brit. Mycol. Soc. Trans. **10**: 198. 1925.

CORTICIUM KOMABENSIS [!] P. HENN., Bot. Jahrb. **32**: 38. 1902. Syn.: *Peniophora corticalis* var. *komabensis* (P. Henn.) Höhn. & Litsch., Ak. Wiss. Wien Sitzungsber. Math.-Naturw. Kl. **116**, **1**: 744. 1907. Cf. Höhnel & Litschauer, l. c.

CYSTOTHYRIUM MAGELLANICUM SPEG., Cordoba Acad. Nac. Cienc. Bol. **11**: 300. 1887. Petrak & Sydow, Ann. Mycol. **33**: 159. 1935, state that the type material is immature and the spore-characters incorrectly described. They do not, however, suggest that more than the one fungus is present. Spegazzini published two new species with the genus, and gave no indication that *C. magellanicum* was, as Petrak & Sydow state, the "Typusart."

DECAMPIA HOOKERI (BORRER) MASSAL., Sulla Lecidea Hookeri di Schaerer 7. 1853. Syn.: *Verrucaria Hookeri* Borrer in Engl. Bot. Suppl. **1**: [text for] pl. 2622 (fig. 2). 1831. Cf. Kiessler in Rabenh. Kryptogamen-Fl. 2 Aufl. **8**: 503. 1930, where also will be found two pages and a half of synonyms, most (but not all) likewise nomina confusa.

EURYACHORA SEDI * RUMICIS KARST., Bidr. Känned. Finl. Nat. Folk **23**: 228. 1873. Syn.: *Dothidella Rumicis* (Karst.) Sacc., Syll. Fung. **2**: 630. 1883; *Dictyochora Rumicis* (Karst.) Theiss. & Sydow, Ann. Mycol. **12**: 274. 1914. Petrak & Sydow, Ann. Mycol. **21**: 383. 1923, report that Karsten's species is a synonym of *E. thoracella* Karst. and his name is not a nomen confusum, but that the diagnosis of *Dictyochora* included the characters both of the *Euryachora* and a *Pleospora*. They therefore declare *Dictyochora* a nomen confusum. Since "the type . . . of a generic name is a species" (Art. 18), it would appear that *Dictyochora* is rather a synonym of whatever genus *D. Rumicis* belongs to.

FUMAGO VAGANS PERS., Mycol. Eur. **1**: 9. 1822. Bisby 1949 p. 11 writes that *Fumago* "was considered [by Woronich] a nomen confusum." Woronich (Ann. Mycol. **24**: 261–4) gives it as his opinion and that of earlier authors (cf. Berkeley & Montagne, Hort. Soc. Lond. Jour. **4**: 244 1849), that "the whole first section of the genus *Fumago* Pers. is no more than a mixture of *Cladosporium herbarum* Link and other fungi, such as *Mystrosporium*, *Triposporium*, etc."; he states that only by examination of authentic material can this tangle be straightened out. Now this is not evidence, nor even an assertion, that "the characters of the group were derived from two or more entirely discordant elements . . . erroneously supposed to form part of the same individual" (Art. 64). Persoon lists six genera as hosts of *F. vagans*, thereby implying at least as many occurrences (individuals). It has been argued (in Mycologia **40**: 635–637) that the intent and essence of Art. 64, the nomen-confusum rule, is not that the author applied one name to different elements (as, for example, Fries did in describing the genus *Agaricus* and the species *Hypochnus olivaceus* (El. **1**: 197; cf. Mycologia **31**: 299)), but that

the author supposed discordant elements to form part of the same individual. Otherwise any name applied to a group from which subsequent authors detached segregates could be a nomen confusum. Quite likely Persoon lumped a number of sooty growths in his *F. vagans*, as did all his contemporaries dealing with fungi whose differential characters are revealed only by the microscope. But until a type specimen has been found, established as such, and shown not merely to bear two fungi but to have had their characters combined in Persoon's diagnosis, the name is not, it is submitted, a nomen confusum. The name is of little consequence; the conflicting principles can have an important effect in all botanical nomenclature. See under *Capnodium* among nom. cons. prop.

HELICOBASIDIUM HYPOCHNOIDEUM (HÖHN.) HÖHN., Ak. Wiss. Wien Sitzungsb., Math.-Naturw. Kl. **116**, **1**: 85. 1907. Syn.: *Stypinella hypochnoides* Höhn., Ann. Mycol. **3**: 324. 1905. The type specimen consists of a fructification of *Pellicularia flavescens* (Bon.) Rogers overgrown by a minute species of *Helicobasidium*. Since the former fungus supplies many of the characters (and the specific epithet) published by Höhnel, both of his names are nomina confusa.

HENNINGSOMYCES PULCHELLUS SACC., Syll. Fung. **17**: 689. 1907. Listed as a nomen confusum by Bisby (p. 29), with reference to Hansford. Hansford, however, in Imp. Mycol. Inst. Mycol. Papers **15**: 60. 1946, appears to consider the genus autonomous and the species valid but of doubtful position, implying that the three types of fructification present in the type may belong to the life cycle of one species.

HYALODOTHIS CLAVUS PAT. & HAR., Soc. Mycol. France Bul. **9**: 210. 1893. Cf. Theissen & Sydow, Ann. Mycol. **12**: 186. 1914. These authors do not reject *H. clavus* as a nomen confusum, preferring to retain the name for one of the components. According to their account, however, the generic and specific names must be rejected under Art. 64.

LUCIDIUM PYTHIOIDES LOHDE, Ges. deutsch. Naturf. Aertzte Tagebl. Versamml. **47**: 205. 1874. Cf. Butler, India Dept. Agr. Mem. Bot. Ser. **1** (5): 88. 1907.

MELANOMYCES QUERCINUS SYD., Ann. Mycol. **15**: 196. 1917. Cf. Petrak, Sydowia **1**: 188. 1947.

METASPHAERELLA SUBANTARCTICA SPEG., Cordoba Acad. Nac. Cienc. Bol. **27**: 376. 1924. Cf. Petrak & Sydow, Ann. Mycol. **34**: 42. 1936.

MYRIOBLEPHARIS PARADOXA THAXT., Bot. Gaz. **20**: 484. 1895. Cf. Waterhouse, Brit. Mycol. Soc. Tr. **28**: 94. [1946].

MYRIOCARPA CYTISI FUCKEL, Nassau. Ver. Naturk. Jahrb. **23**, **24**: 116. 1870. Syn. *Anthostomella Cytisi* (Fuckel) Sacc., Syll. Fung. **1**: 290. 1882. Cf. Höhn., Ak. Wiss. Wien Math.-Naturw. Kl. **116**, **1**: 621. 1907.

PERIASTER STRONGYLODONTIS THEISS. & SYD., Ann. Mycol. **14**: 452. 1916. Cf. Petrak, Ann. Mycol. **29**: 390. 1931.

PERONOSPORA NICOTIANAE SPEG., Rev. Argent. Hist. Nat. **1**: 36. 1891. Cf. Clayton & Stevenson, Phytopath. **25**: 516–521. 1925; ibid. **33**: 106–7, 111. 1943; Shaw, ibid. **39**: 675. 1949. Since "none of the four Spegazzinian specimens studied by Clayton and Stevenson possesses both 'oospores' and conidia" (Shaw), the "discordant elements" were presumably not "supposed to form part of the same individual" (Art. 64); *P. Nicotianae* would then seem not to be a nomen confusum, as Shaw would have it, unless *all* names exemplified by several collections in which more than one taxonomic group is represented are nomina confusa. Since the only specimen in Spegazzini's herbarium collected before the date of publication of his name shows only oospores (Clayton & Stevenson 1935 p. 516), that specimen and its oospores would normally be held to be the type of *P. Nicotianae*. Clayton & Stevenson judge that it is not a peronospora.

PHAEODOTHIS TRICUSPIDIS SYD., Ann. Mycol. **2**: 166. 1904. Cf. Sydow, Ann. Mycol. **37**: 192. 1939.

PHAEOMARSONIA YERBAE SPEG., Buenos Aires Mus. Nac. Anal. iii **10**: 138. 1908. Petrak & Sydow, Ann. Mycol. **34**: 32. 1936, report that "a fungus corresponding to the description of the author is quite non-existent," but that the spores and perithecia found in the type specimen belong together. According to their account the generic and specific names are nomina dubia and not n. confusa.

PHRAGMOCARPELLA ICHNANTHI (HENN.) THEISS. & SYD., Ann. Mycol. **13**: 601. 1915. Syn.: *Roumegueria Ichnanthi* Henn., Hedwigia **47**: 256. 1908. Cf. Petrak, Ann. Mycol. **29**: 349. 1931.

PIPTOSTOMUM DOMINGENSE LÉV., Ann. Sci. Nat. Bot. iii **3**: 65. 1846. Cf. Petrak & Sydow, Ann. Mycol. **27**: 109. 1929.

PSILOTHECIUM INNUMERABILE FUCKEL, Fung. Rhen. Exs. 1571. 1865. Syn.: *Septoria innumerabilis* (Fuckel) Sacc., Syll. Fung. **1**: 290. 1882; *Stagonospora innumerabilis* (Fuckel) Sacc., Syll. Fung. **3**: 446. 1884. Cf. Höhnel, Ak. Wiss. Wien Math.-Naturw. Kl. Sitzungsb. **116**, **1**: 621. 1907; BMS 2 p. 290.

SCIRRHIOPSIS HENDERSONIOIDES P. HENN., Bot. Ver. Prov. Brandenb. Verh. **47**: XII. 1906. Cf. Höhnel, Ak. Wiss. Wien Sitzungsb. Math.-Naturw. Kl. **120**, **1**: 409. 1911.

STEREUM GUADELUPENSE PAT., Soc. Mycol. Fr. Bul. **15**: 201. 1899. Cf. Höhnel & Litschauer, Ak. Wiss. Wien Sitzungsber. Math.-Naturw. Kl. **116**, **1**: 753. 1907.

THEISSENULA CLAVISPORA SYD., Ann. Mycol. **12**: 198. 1914. Cf. Petrak, Ann. Mycol. **26**: 410. 1928; Hansford, Imp. Mycol. Inst. Mycol. Papers **15**: 91. 1946.

TRECHISPORA ONUSTA KARST., Hedwigia **29**: 147. 1890. Bresadola implied that there were two fungi present in the type collection, but did not state that the name was based on both "elements . . . erroneously supposed to form part of the same individual" (Art. 64). After study of the type Rogers declared that the alien mycelium whose presence Bresadola had noted was not included in Karsten's description of the species (cf. Mycologia **36**: 75–76. 1944). Lundell & Nannfeldt, Fung. Exs. Suec. Praes. Upsal. Fasc. XXIX–XXX. no. 1415a. 1947, state that "Karsten's name . . . seems to be a *nomen confusum*"; the basis for their opinion is not given, but probably is the material presented by Bresadola and Rogers.

VERMICULARIELLA ELYMI OUD., Nederl. Kruidk. Arch. iii **1**: 495. 1898. Cf. Petrak, Ann. Mycol. **42**: 62. 1944.

VOLVOBOLETUS VOLVATUS (PERS.) P. HENN. in E. & P., Nat. Pflanzenfam. **1**, **1** **: 196. 1898. Syn.: *Boletus volvatus* Pers., Mycol. Eur. **2**: 124. 1825; *Gyrodon volvatus* (Pers.) Opat., Comm. Fam. Fung. Boletoid. 5. 1836; *Uloporus volvatus* (Pers.) Quél., Fl. Mycol. France 411. 1888. Cf. Lloyd, Myc. Writ. **3**, M. N. 444. 1909; Höhn., Ak. Wiss. Wien Sitzungsb., Math.-Naturw. Kl. **119**, **1**: 881. 1910; Ulbrich, Deutsch. Bot. Ges. Ber. **57**: 389. 1939; Neuwirth, Stud. Bot. Čech. **9**: 128. |1949|. — Quélet and Höhnel opined that Persoon's species was based on a bolete parasitized by *Hypomyces*. The weight of the evidence presented by Ulbrich indicates that it was rather a teratological *Amanitopsis*. In that case *B. volvatus* and the other names based on it are illegitimate under Art. 65, but are not nomina confusa.

XYLOCLADIUM CLAUTRIAVII (PAT.) SYD. in E. & P., Nat. Pflanzenfam. **1**, **1** **: 494. 1900. Syn.: *Ceratocladium Clautriavii* Pat. Cf. Höhn., Ak. Wiss. Wien Sitzungsb., Math.-Naturw. Kl. **118**, **1**: 418. 1909.

NOMINA GENERICA CONFUSA

ARCHILEGNIA APIN. Monotype: *A. latvica* (Apin.) Apin. The number of the journal in which this name was printed is marked as having been issued March 1, 1935. *Archilegnia* was not validly published (Art. 38), and therefore need not be placed on the list of nomina confusa.

ASCOPHORA TODE EX FR. — Listed by Bisby (1949 p. 8) as "apparently a nomen confusum," but without reference or evidence.

BYSSOTHECIUM FUCKEL. Monotype: *B. circinans* Fuckel.

CERATOCLADIUM Pat., non *Ceratocladium* Corda, Prachtfl. 41. 1839. Cf. *Xylocladium* Syd.

CHAETASPIS Syd. Monotype: *C. Stenochlaenae* Syd.

CHAOS L., Syst. Nat. 12 ed. **1**: 1326. 1766. — Listed by Bisby (1949 p. 14) as "a nomen confusum . . . rejected by Fries." The genus originally included five species, of which one, *C. Prometheus*, was published in Syst. Nat. 10 ed. **1**: 821. 1758, as *Volvox Chaos*, characterized as "Prometheo inconstantior." Since that species furnished the generic name for *Chaos*, it should be regarded as the type. To attempt to settle the application of the name *V. Chaos* would be to invite engulfment in a recent extensive and spirited controversy among zoologists about a zoological entity known as *Chaos Chaos*. It is enough here to say that the species and genus are widely accepted as amoebae. Relying on reports of some of Baron Munchausen's researches, Linnaeus included *C. Ustilago*, a name for a number of smuts, and *C. fungorum*, a name for the "seeds" of many fungi. Fortunately, *Chaos* pertains to zoological rather than mycological nomenclature.

COCCIDIOPHTHORA Syd. Monotype: *C. variabilis* Syd.

CYSTOTHYRIUM Speg. Cf. *C. magellanicum* Speg.

DECAMPIA Massal. Monotype: *D. Hookeri* (Borrer) Massal.

DIBLEPHARIS Lagerh., K. Svensk. Vet.-Akad. Handl. Bih. **25**, **Afd. 3**(8): 39. 1900, was based on *Monoblepharis insignis* Thaxt. and *M. fasciculata* Thaxt., one of which must be its type. Neither is known to be a nomen confusum. Lagerheim ascribed to these species and to his genus biflagellate zoospores, which Sparrow (Aquat. Phycom. 467. 1943) thinks possibly "extraneous, parasitic." Whether or not they are, the status of *Diblepharis* is determined by its type species, and the name is presumably a synonym of *Monoblepharis* rather than a nomen confusum.

DICTYOCHORA Theiss. & Syd. Monotype: *Euryachora* [*Sedi* *] *Rumicis* Karst.

FUMAGO Pers. Lectotype: *F. vagans* Pers.

HENNINGSOMYCES Sacc. (non OK., Rev. Gen. Pl. **3**(**2**): 483. 1898). Monotype: *H. pulchellus* Sacc.

HYALODOTHIS Pat. & Har. Type: *H. clavus* Pat. & Har. (of two original species the other was assigned here "with doubt.")

LUCIDIUM Lohde. Monotype: *L. pythioides* Lohde.

MELANOMYCES Syd. Monotype: *M. quercinus* Syd.

MELIOLOPSIS (SACC.) SACC. Bisby (1949 p. 37) says, "nomen confusum or dubium," referring to the comments of Theissen & Sydow in Ann. Mycol. **15**: 465. [1918]. The latter authors state that "*Meliolopsis* (Syll. Fung. I p. 68), originally a subgenus of *Meliola*, was later (Syll. IX), with all the species earlier named, elevated to generic rank." This is only partly true; in Syll. IX none of the species in the subgenus is transferred to the genus *Meliolopsis*. They then state, "M. *microthecia* Thuem. is therefore to be considered the type." This is completely a non sequitur; *M. microthecia* is no more than one of the six original species. Finally, of that form they write, "the species needs reexamination." *Meliolopsis* may be a nomen dubium; there is no evidence at hand that it is a nomen confusum.

METASPHAERELLA SPEG. Monotype: *M. subantarctica* Speg.

MYCODERMA PERS., Mycol. Eur. **1**: 96. 1822. Persoon's name was published for four species, constituted by the tough pellicle formed on the surface of as many vegetable infusions. Ciferri & Redaelli discuss in Ann. Mycol. **27**: 271–278 the application of this name by various later authors — all, of course, entirely irrelevant. Of Persoon's own use of the genus, they write (p. 273), "these microorganisms . . . might have been true *Mycoderma* mixed with other Torulopsidaceae and Schizomycetes" — i.e., there is a "true *Mycoderma*," but Persoon may not have had pure cultures — and further (p. 277), "the complete morphological characters of [Persoon's *Mycoderma*] cannot be laid down precisely because of the impossibility of tracing the types" — i.e., *Mycoderma* is a nomen dubium. Evidence is needed to determine whether such pellicles as Persoon described are produced by a single organism (contaminants being of no importance here unless they furnished some of the rather sketchy characters published by Persoon); in its absence, *Mycoderma* and its species are better regarded as nomina dubia, subject to reestablishment (Rec. XXXVII) than as nomina confusa.

MYRIOBLEPHARIS THAXT. Monotype: *M. paradoxa* Thaxt.

MYRIOCARPA FUCKEL. Lectotype (species treated in greater detail, and showing all characters): *M. Cytisi* Fuckel.

PERIASTER THEISS. & SYD. Type: *P. Strongylodontis* Theiss. & Syd.

PHAEODOTHIS SYD. Type: *P. Tricuspidis* Syd.

PHAEOMARSONIA SPEG. Monotype: *P. yerbae* Speg.

PHRAGMOCARPELLA THEISS. & SYD. *P. Ichnanthi* (q.v.) is the type according to Petrak; but no type is designated in the original publication. The genus originally included three species, of which the third is aberrant (in spore-septation) and hardly eligible. Since *P. Ichnanthi* received the most attention from the authors, Petrak's selection may well be accepted.

PHYLLONOCHOETA FRAG. & CIF. Type: *P. Solani* Frag. & Cif. The references to the species were given in Rogers 1949 p. 490, but the n. conf. gen. omitted from the list.

PIPTOSTOMUM LÉV. Monotype: *P. domingense* Lév.

PSILOTHECIUM FUCKEL. Monotype: *P. innumerabile* Fuckel.

SCIRRHIOPSIS P. HENN. Monotype: *S. hendersonioides* P. Henn.

THEISSENULA SYD. Monotype: *T. clavispora* Syd.

TRECHISPORA KARST. Monotype: *T. onusta* Karst.

TRICHOCHORA THEISS. & SYD. Type: *Ophiodothis marginata* Theiss. The references to the species were given (under *T. marginata*) in Rogers 1949 p. 490, but the generic name was inadvertently omitted from the list.

VERMICULARIELLA OUDEM. Type: *V. Elymi* Oudem.

VOLVOBOLETUS HENN. Monotype: *V. volvatus* (Pers.) P. Henn.

XYLOCLADIUM SYD. Type: *Ceratocladium Clautriavii* Pat.

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QUARTERMASTER CULTURE COLLECTION

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The fundamental nature of the fungal and bacterial deterioration of materiel constituted one of the first pioneering problems with which the Quartermaster Research and Development Laboratories were directly concerned. Today, it continues to be one of our emphasized areas of investigational activity.

Through the far-sighted research vision of General Georges F. Doriot and Dr. Edwin L. Gustus, former Chief and former Technical Director respectively, of the Military Planning Division of the Office of The Quartermaster General, Professor William H. Weston, Jr. of Harvard University was invited in 1943 to propose, implement and direct a basic approach to the prevention of deterioration of cotton textiles. This program was executed to complement the applied empirical research program already under way.

Professor Weston's long-range plan evolved around three phases. The first two were a determination of the causal organisms and a study of their mechanism of action. Based on the information garnered from these two phases, pioneering work was initiated on the third phase, a development of new and improved methods of prevention. This approach set the pattern for subsequent Quartermaster research on the biological deterioration not only of cotton but of other military items, such as leather, wool, paper, and plastic products.

A monograph (35) painting an integrated picture of the microbiological attack on cellulose and on cotton textiles is nearing completion. Other publications and reports listed in the appendix provide a general review of our activities in the biological deterioration of materiel. The present paper by Reese, Levinson, Downing, and White treats in some detail one phase of our pertinent investigational interests. In it are listed all of the cultures being maintained in our collection of fungi, bacteria, actinomycetes and yeasts isolated by our own and by collaborating laboratories from exposed and deteriorating materiel. With the help of many specialists we have conscientiously followed the spirit of Professor Weston in guarding against ill-defined and taxonomic errors, unfortunately frequent in the literature, which have vitiated many of the results of microbiological research.

Contributors to this culture collection were many, selfless and capable. The signal efforts of Professor Weston were supplemented by the late Dr. D. H. Linder, Dr. W. L. White, Dr. K. B. Raper, Dr. N. R. Smith, Dr. G. W. Martin and others who provided the keen judgment which estab-

lished the sound taxonomic position of the collection. Drs. E. S. Barghoorn, G. F. Weber, H. W. Reuszer, and W. G. Hutchinson have been responsible for most of the isolation and field observations. The U. S. Army Chemical Corps and the U. S. National Defense Research Committee have been most generous in requesting the amalgamation of their respective collections with our own. The resultant collection is the most complete and dependable one for experimental microbiology associated with deterioration of materiel. We wish to acknowledge the valuable and unstinting contributions of these and the hundreds of others who have participated in the joint effort. We wish particularly to point out the expeditious coordination by Mr. Richard Wells, a member of Dr. S. J. Kennedy's Quartermaster team of textile experts. It was mainly through Mr. Wells' effort that the many laboratories were able to operate effectively with a minimum of administrative synapses during the hectic war days.

It has been the established policy of our laboratories to share our scientific tools with those of our colleagues collaborating with United States Departments of the Army, Navy and Air Force. In the case of the culture collection, this has been a *de facto* service. Thousands of cultures have been furnished during the past years to laboratories in this country and those of our allies for use in research and procurement testing. The Quartermaster Corps joins me in extending an invitation to scientific collaborators of the U. S. National Military Establishment for continued use of our culture collection.

RALPH G. H. SIU
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Quartermaster General Laboratories

GENERAL CONSIDERATIONS

This report summarizes that phase of the Tropical Deterioration program dealing with the isolation and determination of microorganisms involved in the deterioration of materiel. This program was sponsored by the U. S. National Defense Research Committee and The Office of the Quartermaster General. The present authors wish to emphasize the fact that their role has been primarily the collation of loose ends. In doing so, the authors have reduced the collection of actively growing cultures to a size (830 cultures) which, it was felt, would not impose too great a burden on the present staff. The reduction was made by eliminating replications. For instance, of 30 *Aspergillus fumigatus* isolates, five were selected for maintenance in the active collection. Several criteria were used as a basis for the selections:

(a) Frequency with which the isolate has been used in studies carried on here and elsewhere
(b) Morphological or physiological variation within the species
(c) Authenticity of identification
(d) Nature of the substratum from which the organism was isolated
(e) Locality of isolation

The collection contains a wide variety of organisms, and sufficient numbers within a species to exhibit whatever variation exists. None of the original isolates, however, was discarded. Those not actively maintained on agar have been lyophilized, or kept under mineral oil. In the desiccated state most of these will remain viable for several years, and will be available for future study.

This is a collection of microorganisms of tropical and subtropical origin. The isolations from deteriorating materiel were made in Florida and in Panama at the site of the exposure tests, and at the Jeffersonville and Philadelphia Quartermaster Depots from samples carefully wrapped and sent in from the South Pacific and from Asiatic regions. All samples were carefully unwrapped in a sterile room and precautions taken to prevent contamination by the local air borne flora. Sterile instruments were used to tease out fibers from decomposing areas. The fibers were then plated out on various media. In Philadelphia, the following substrata were used:

(a) cellulose dextrin agar,
(b) nutrient agar,
(c) potato dextrose agar,
(d) acidified potato dextrose agar, and
(e) filter paper strips in nutrient salts solution.

The Jeffersonville laboratory used an equally wide, but different, set of conditions, the favorite medium there being grass agar. Transfers were made from the incubated plates as soon as growth was visible. Isolated fungi were maintained on potato dextrose agar and bacteria on Difco nutrient agar. The method of isolation used in Panama was similar to that described above, but in most cases potato dextrose agar was the only medium used. In Florida, and occasionally in Panama, the techniques included washing of samples followed by plating out.

The type of samples examined included cotton and wool fabrics, paper, leather, and plastic. Since these are complex entities, the isolated organism may have been growing on any one of the constituent compounds. From the isolation data alone, it is impossible to say that the isolates from cotton were degrading cellulose, and not starch, waxes, or other chemical compounds in the cloth. For many of the isolates, data have been gathered relative to their ability to attack cellulose (47) and wool (49) in pure culture. If an isolate from decomposing cotton, for example, were found capable of attacking cellulose, the organism might well be considered the agent active in the field.

Investigators concerned with protecting materiel against microbial attack should know which organisms are most likely to be encountered. The data in the various reports — and particularly that of Barghoorn — have been summarized below (table 1). It is apparent that most of the organisms are of wide occurrence, and that the same species are found in Florida, in Panama and in the South Pacific area. Even the frequency with which many species were isolated is similar for the three areas (*Aspergillus versicolor* group, *Trichoderma viride*, *Penicillium citrinum*). There are,

TABLE 1. THE MOST FREQUENT ISOLATES OF QM CULTURE COLLECTION ARRANGED ACCORDING TO FREQUENCY

Southwest Pacific		Panama		Florida	
Organism	% of isolates	Organism	% of isolates	Organism	% of isolates
Aspergillus niger group	5.8	*Trichoderma viride* **	11.1	*Penicillium luteum* series *	5.4
Memnoniella echinata **	4.4	*Penicillium citrinum*	8.1	*Penicillium funiculosum* series	5.1
Aspergillus versicolor group	4.4	*Botryodiplodia theobromae*	5.5	*Penicillium citrinum*	4.6
Chaetomium globosum **	4.0	*Pullularia pullulans*	4.6	*Aspergillus versicolor* group	4.3
Trichoderma viride **	3.7	*Aspergillus versicolor* group	3.2	*Aspergillus niger* group	3.6
Aspergillus flavus-oryzae group	3.6	*Fusarium solani* *	3.0	*Aspergillus flavus-oryzae* group	3.5
Penicillium citrinum	3.1	*Fusarium moniliforme* **	3.0	*Chaetomium globosum* **	3.5
Aspergillus nidulans group	2.4	*Pestalotia virgatula* *	1.8	*Trichoderma viride* **	3.4
Botryodiplodia theobromae	2.1	*Fusarium javanicum* **	1.6	*Paecilomyces varioti*	1.9
Aspergillus terreus **	2.0	*Gliocladium roseum* *	1.6	*Fusarium solani* *	1.6
Chaetomium funicolum **	1.8	*Fusarium diversisporum*	1.3	*Aspergillus terreus* **	1.4
Cladosporium herbarum *	1.5	*Aspergillus niger* group	1.1	*Penicillium chrysogenum* series	1.4
Pullularia pullulans	1.5	*Phialophora lignicola*	1.1	*Cylindrocephalum aureum*	1.4
Aspergillus ustus	1.5	*Fusarium semitectum* *	1.0	*Fusarium moniliforme* **	0.7
Aspergillus fumigatus **	1.4	*Pestalotia copernica*	0.9	*Pullularia pullulans*	0.4
Aspergillus tamarii	1.3	*Paecilomyces varioti*	0.8	*Gliocladium roseum* *	0.4
Thielavia sepedonium **	1.3	*Curvularia lunata* **	0.7	*Curvularia lunata* **	0.4
Phoma terrestris **	1.1	*Penicillium luteum* series *	0.5	*Memnoniella echinata* **	0.3
Syncephalastrum racemosum	1.0	*Aspergillus flavus-oryzae* group	0.4	*Pestalotia virgatula*	0.2
Paecilomyces varioti	0.9	*Memnoniella echinata* **	0.3	*Phialophora lignicola*	0.2

* Cellulolytic — less than 50% loss in tensile strength of 3.3 oz. cotton sheeting in two weeks.
** Strongly cellulolytic — 50–100% loss in tensile strength of 3.3 oz. cotton sheeting in two weeks.

on the contrary, some differences in the frequency of occurrence of a few species. *Memnoniella echinata*, the second most common isolate from S. W. Pacific samples, is found also in Florida and Panama, but is much less often isolated. *Pullularia pullulans*, common in Panama, is less frequent in the other two zones. *Botryodiplodia theobromae*, third in frequency in Panama, and ninth in S. W. Pacific, does not appear among the Florida collections. Other points of similarity and of divergence are obtainable by an examination of the table. In any case, if one were to become familiar with but 25 fungi, he would be able to recognize about 50 per cent of the isolates made from deteriorating materials such as those listed above. More detailed information on frequency is available by careful examination of the catalogue.

For an intelligent approach to mildew control, the part played by each of these common organisms should be determined. Our present results cover only the ability of the organisms to attack cellulose in pure culture. This information has been incorporated into table 1, one asterisk denoting weak, two asterisks strong, cellulolytic activity. Since only one half of the organisms listed are capable of growth on cellulose, the others are either growing at the expense of some other component of the fabric, or are air borne contaminants. The presence of sizing would be sufficient to account for development of most of the other fungi, since starch is readily utilized by very many microorganisms. It is interesting to note the absence from the Panama list of *Chaetomium globosum*, a fungus commonly used in fungicide testing.

A note of caution should be inserted relative to the weight to be given the above data. Much effort has been expended by our staff in examining fabrics undergoing decomposition for evidence of actual *fruiting* of the fungus on the fabric. White (52) has particularly noted the frequent occurrence of *Memnoniella echinata* in the tropics, and of *Stachybotrys atra* in temperate climes. We have not seen fruiting structures of *Trichoderma viride*, *Penicillium* or *Aspergillus*. It may be that the latter organisms do not grow on the cloth, but are isolated with great frequency only because their air-borne spores are abundant on all substrata in that vicinity. On the other hand, it may well be that the hyaline conidiophores of *Trichoderma*, *Aspergillus* and *Penicillium* rapidly disappear, whereas the colored conidiophores of *Memnoniella* and *Stachybotrys* are more persistent. The black aspect of the latter also makes them more obvious.

The data on frequency of bacterial species are much more limited. Only information relative to the S. W. Pacific samples is available. Slightly more than 50 per cent of the bacteria have been identified. The genus *Bacillus* was segregated and the isolates identified by Dr. N. R. Smith (40). This genus accounts for 40 per cent of all bacterial isolates, *Bacillus cereus* and *Bacillus megatherium* being the most common. None of the isolated members of the genus *Bacillus* attacks cellulose, but the majority of them can degrade autoclaved wool. The Actinomycetes make up only 5 per cent of the total bacterial isolates. A few of these are cellulolytic. The unidenti-

fied bacteria, chiefly gram negative non-cellulolytic rods, make up roughly 50 per cent. The cellulose decomposing schizomycetes, bacteria and Actinomycetes, are relatively few in number accounting for only 3 per cent of the total isolates.

For most of the organisms in our collection, relatively few experimental data are available. On the other hand, some have been the subjects of detailed study. On the basis of the knowledge accumulated, it is possible to suggest various organisms for studies dealing with various substrata.

(a) *Electrical insulation*: Members of the *Aspergillus glaucus* group and particularly *Aspergillus repens* (QM *360*, *361*), frequently develop well on insulation (E. A. Weaver). It has been found that these organisms can withstand high osmotic concentrations in the substratum, and will develop under conditions in which the relative humidity is as low as thirty per cent. Some strains fail to grow on agar unless the osmotic concentration is increased considerably above that found in the usual media.

(b) *Paints*: A few fungi appear to grow on and to blemish painted surfaces. Among the most common are:

1. *Pullularia pullulans* (QM *279c*)
2. *Cladosporium herbarum* (QM *489*)

(c) *Nylon*: To our knowledge the only organism isolated from nylon is *Tritirachium roseum* (QM *494*) received from Wright Field. It is quite possible that growth here was on the plasticizer or on contaminating organic matter, and not on the nylon itself. W. D. Gray (4) of the Jeffersonville Depot tested 101 microorganisms of various genera for their ability to grow on nylon (Type 2, duPont). Six isolates were claimed to be able to use nylon as a nitrogen source: *Botryodiplodia* sp. (2) (QM *603*), *Monascus* sp., *Trichothecium* sp., *Spegazzinia tessarthra* (QM *840*), *Blennoria* sp. (QM *590*). None was able to use nylon as a carbon source.

(d) *Wool*: As has been pointed out (49), few of the fungi, except the dermatophytes, are capable of attacking *non-autoclaved* wool. Two such non-pathogenic organisms are *Myrothecium verrucaria* (QM *460*) and *Actinomyces* sp. (QM *B1477*). The dermatophytes studied most completely in our laboratories have been *Microsporum gypseum* (QM *196*), and *Trichophyton mentagrophytes* (QM *253*). It cannot be stated too emphatically that such organisms should be handled only by personnel familiar with the pathogenicity of these fungi. Many additional microorganisms can grow on *autoclaved* wool. Those most active in our tests include:

Bacillus megatherium (QM *B1193*)
Bacillus cereus (QM *B476*)
Aspergillus flavus (QM *70a*)
Aspergillus terreus (QM *82j*)
Alternaria tenuis (QM *26a*)
Fusarium moniliforme (QM *427*)

(e) *Cellulose*: Many microorganisms can degrade cellulose. Some of the more active representatives of the different groups are indicated below:

1. *Myrothecium verrucaria* (QM *460*), one of the most active of cellulolytic microorganisms, yet rarely isolated from exposed cotton fabrics.
2. *Aspergillus fumigatus* (QM *45h*) } These two fungi grow
3. *Aspergillus terreus* (QM *82j*) } actively at 40°C.
4. *Memnoniella echinata* (QM *1c*), an active cellulose destroying fungus of frequent occurrence; requires biotin.
5. *Sporocytophaga myxococcoides* (QM *B490*), represents an active bacterial cellulose destroyer of frequent occurrence on buried samples. In experiments where filtrates are required, the mucilaginous substance produced often makes filtration difficult.
6. *Actinomyces* sp. (QM *B814*), an active cellulolytic organism representing the Actinomycetes.
7. *Trichoderma viride* (QM *6a*), one of the most frequent cellulolytic isolates; of moderate cellulolytic activity.
8. *Cellvibrio vulgaris* (QM *B4*), an active cellulolytic bacterial organism isolated in the Canal Zone with a fair degree of frequency.
9. *Gliomastix convoluta* (QM *4c*)

(f) *Fabrics*: The following organisms have been used widely in specifications set up by government agencies for procurement testing:

1. *Chaetomium globosum* (QM *459*, USDA *1042.4*)
2. *Myrothecium verrucaria* (QM *460*, BPI *1334.2*)
3. *Aspergillus niger* (QM *458*, TC *215–4247*)
4. *Aspergillus ustus* (QM *891*, JQMD *272*)
5. *Trichoderma viride* (QM *365*, BPI *T–1*)

(g) *Leather*: Many organisms especially Aspergilli and Penicillia have been isolated from leather but the damage done is of a questionable nature.

1. *Aspergillus niger* (QM *458*)

(h) *Plastics*: Dr. J. V. Harvey (21) has devised a method for evaluating fungus resistance of plastic coated fabrics which involves an estimate of the amount of visible growth, coupled with a measure of stiffness. An increase in stiffness accompanies fungal degradation. He recommends that the following test organism be used:

1. *Aspergillus versicolor* (QM *4g*)

The reports on which the list is based are not generally available but may be obtained on loan from our laboratories. They are listed below under "Contractual Reports." A second group of reports is also appended. These are included because they deal with the microorganisms in the collection, and because they are pertinent to the subject of deterioration of materiel.

CONTRACTUAL REPORTS

1. **Barghoorn, E. S.** 1945. Studies of the deterioration of textiles under tropical conditions in the Canal Zone. OSRD Rept. 4807.

2. ————. 1946. Field studies of the deterioration of textiles under tropical conditions. Textile Series Rept. 24. Microbiological Series Rept. 4 of Res. & Dev., OQMG.
3. ————. 1948. Methods of isolation of fungi studied in QM Corps research in tropical deterioration. Rept. uncirculated.
4. **Gray, W. D.** 1945. History of the Biological Laboratory: Isolation and identification of fungi involved in tropical deterioration. Jeffersonville QM Depot — Rept. 303.
5. ————. 1946. Isolations of microorganisms from equipment forwarded from New Guinea. Jeffersonville QM Depot — Rept. 312.
6. ————. 1946. Isolations of microorganisms from equipment forwarded from Guadalcanal. Jeffersonville QM Depot — Rept. 323.
7. **Heimsch, C.** 1946. Tropical Deterioration of Equipment and Materials. OSRD Rept.
8. **Hutchinson, W. G., S. H. Davis, and J. A. Jump.** 1945. The tropical deterioration testing station at Barro Colorado Island. OSRD Rept. 5690.
9. **Linder, D. H.** 1946. Rept. at AAAS in St. Louis in March 1946.
10. **Reuszer, H. W.** 1945. Studies on the role of bacteria in the deterioration of cotton duck. OSRD Rept. 4806.
11. ————. 1945. Bacteria culture collection, OSRD Rept. 5682.
12. ————. 1946. Maintenance and identification of bacterial cultures isolated from material subjected to tropical deterioration. QMC Rept. 59.
13. **Smith, Nathan R., and Marie E. Wenzel.** 1947. Identification of spore-forming bacteria for the OQMG, Army Service Forces. Special Rept. 22. Div. of Soils, Fertilizers, & Irrigation. USDA. Jan. 6, 1947.
14. **Weston, W. H.** 1945. Tropical Fungus Culture Collection. OSRD Rept. 5681.
15. ————. 1949. Tropical deterioration: Preparation and preservation of fungus cultures of military importance. QMC Rept. 60.

RESEARCH AND PUBLISHED REPORTS

16. **Buell, C. B., and W. H. Weston.** 1947. Application of the mineral oil conservation method to maintaining collections of fungous cultures. QM General Lab. Topical Rept. 18, 1–3.
17. **Burkholder, P. R., and R. G. H. Siu.** 1947. Studies on degradation of cellulose and derivatives by microorganisms. QM General Lab. Topical Rept. 23, 1–22.
18. **Darby, R.** 1949. Resistance of some cellulose derivatives to the fungus *Myrothecium verrucaria*. QM General Lab. Res. Rept., Microbiological Series 10.
19. **Gray, W. D., and G. W. Martin.** 1946. Improvements on the soil burial testing method. QM General Lab. Topical Rept. 14, 1–17.
20. ————, **and** ————. 1947. The growth of fungi on asphalt-treated paper. Mycologia **39**(5): 587–601. 7 fig.
21. **Harvey, James V.** 1949. Testing the fungal resistance of plastic coated fabrics and plastic films. QM General Lab. Res. Rept., Microbiological Series 13.
22. **Levinson, H. S.** 1948. Bacteria involved in cellulose degradation. QM General Lab. Res. Rept., Microbiological Series 9.
23. ————, **and R. DiLello.** 1947. Assay for cellulolytic activity of cultures of bacteria in the QM Bacteria Collection. QM General Lab. Topical Rept. 25, 1–9.
24. **Mandels, G. R., and A. Norton.** 1948. Physiology of spores of the cellulolytic fungus *Myrothecium verrucaria*. QM General Lab. Res. Rept., Microbiological Series 11.
25. ————, **and** ————. 1949. Invertase of *Myrothecium verrucaria* spores. QM General Lab. Res. Rept., Microbiological Series 12.
26. ————, **W. H. Stahl, and H. S. Levinson.** 1948. Structural changes in wool degraded by the ringworm fungus *Microsporum gypseum* and other microorganisms. Text. Res. Journ. **18**(4): 224–231. 14 fig.

27. **Reese, E. T.** 1947. On the effect of aeration and nutrition on cellulose decomposition by certain bacteria. J. Bact. **53**(4): 389–400. 7 fig.
28. **Saunders, P., R. G. H. Siu, and R. N. Genest.** 1948. A cellulolytic enzyme preparation from *Myrothecium verrucaria*. J. Biol. Chem. **174**(2): 697–703. 1 fig.
29. **Sinden, J. W., A. J. Mix, and R. G. H. Siu.** 1946. Effect of pH on cellulolytic action of fungi. QM General Lab. Topical Rept. 10, 1–20.
30. ————, ————, **and** ————. 1946. Relation of temperature to decomposition of cellulose by fungi. QM General Lab. Topical Rept. 11, 1–2.
31. ————, ————, **and** ————. 1948. Effect of environment and mineral nutrition on cellulolytic activity of fungi. QM General Lab. Res. Rept., Microbiological Series 8.
32. **Siu, R. G. H.** 1946. Prevention of the microbiological degradation of cotton fabrics. QM General Lab. Topical Rept. 7, 1–7.
33. ————. 1946. Resistance of cyanoethylated cellulose and cotton fabric to microorganisms. QM General Lab. Topical Rept. 8, 1–6.
34. ————. 1947. Fundamental aspects of the prevention of the microbiological degradation of cotton textiles. Amer. Dyestuff Reptr. **36**: 320–323.
35. ————. 1949–50. Microbial action on cellulose. (Book in preparation)
36. ————, **P. R. Saunders, R. Genest, and J. Dagney.** 1946. Effects of sugars on the cellulolytic activity of *Metarrhizium glutinosum*. QM General Lab. Topical Rept. 1, 1–10.
37. **Skoog, F., and M. Hopkins.** 1946. Biotin as a growth factor for *Memnoniella echinata*. QM General Lab. Topical Rept. 12, 1–7.
38. ————, **and** ————. 1946. A tube-culture method for studying growth rates of fungi. QM General Lab. Topical Rept. 9, 1–27.
39. ————, **and** ————. 1947. Sand culture method for fungi. QM General Lab. Topical Rept. 16, 1–13.
40. **Smith, N. R., H. S. Levinson and R. DiLello.** 1947. Identification and examination for cellulolytic activity of sporeforming bacteria in the QM Bacteria collection. QM General Lab. Topical Rept. 21, 1–16.
41. **Stahl, W. H., and B. McQue.** 1949. Microbiological degradation of wool. III. Digestion of normal and modified fibrillar proteins. QM General Lab. Res. Rept., Biochem. Series 3.
42. ————, ————, **G. R. Mandels, and R. G. H. Siu.** 1949. Studies on the microbiological degradation of wool. I. Sulfur metabolism. Arch. Biochem. **20**: 422–432.
43. **Wagner, R. P., H. H. Webber, and R. G. H. Siu.** 1947. The effect of ultraviolet light on cotton cellulose and its influence on subsequent degradation by microorganisms. Arch. Biochem. **12**(1): 35–50. 3 fig.
44. **White, W. L.** 1946. Mycological factors. *In* Report of the Army Air Forces Tropical Science Mission 25–46, 16 fig. (Wright Field, Ohio). 15 May. (Revised as QM General Lab. Topical Rept. 13: 1–44, 29 fig. 29 Nov.).
45. ————. 1946. Deterioration of Quartermaster fabrics in the Tropics. Quartermaster Review **26** (3): 63–64, 67, 4 figs. Nov.–Dec.
46. ————. 1948. Activities and interrelationships of microorganisms responsible for the deterioration of industrial and military materials. Amer. Journ. Bot. **35**: 804.
47. ————, **R. T. Darby, Gladys M. Stechert, and Kathryn Sanderson.** 1948. Assay of cellulolytic activity of molds isolated from fabrics and related items exposed in the tropics. Mycologia **40**(1): 38–84. 3 fig.
48. ————, **and Mary H. Downing.** 1947. The identity of "*Metarrhizium glutinosum*." Mycologia **39**(5): 546–555, 2 fig.
49. ————, **G. R. Mandels, and R. G. H. Siu.** 1950. Fungi in relation to the deterioration of woolen fabrics. Mycologia **42:** 199–223.

50. ————, **and R. G. H. Siu.** 1947. Resistance of resin-impregnated cotton fabrics to microorganisms. Ind. Eng. Chem. **39**: 1628–1632 1 fig.
51. ————, **R. G. H. Siu, and E. T. Reese.** 1948. The black Aspergilli in relation to cellulosic substrata. Bul. Torrey Bot. Club **75**(6): 604–632. 11 fig.
52. ————, **C. C. Yeager, and Helen Shotts.** 1949. History, distribution and economic significance of the cellulose-destroying fungus *Memnoniella echinata*. Farlowia **3**(4): 399–423, 5 pl., 1 text fig.

THE LIST

A few notes are necessary for understanding the following catalogue of cultures.

1. *Penicillium*: It will be observed that no cultures of *Penicillium* have been selected at the present listing for the permanent collection. Isolates of all the species indicated are being maintained but sufficient data are not yet available on which a wise selection can be made. It is expected that this group will be carefully examined during the next year.

2. *Arrangement*: The fungi are placed first, followed by the bacteria including actinomycetes and yeasts. The order is alphabetically by genus and species.

3. *Frequency*: The number of times each species has been isolated is placed in parenthesis after the species name. A "(0)" indicates that the organism was not isolated here, but reached us from some other source.

4. *Cultures on agar*: These are listed by QM number under the species. Bacterial numbers are preceded by a "B," as "QM *B12*."

5. *Activity*: C = cellulose; W = wool; + = active in reducing tensile strength of cloth; − = inactive. Cellulose activities are based on loss in tensile strength of grey cotton duck. The wool has been autoclaved, and is much more susceptible to microbial attack than the natural product.

6. *Identifications*: The names of those who have identified the cultures are listed. Many of the Jeffersonville and Philadelphia cultures included in the list were named by individuals in the respective laboratories.

7. *Substrate and locality*: These are listed specifically in case one wishes organisms from a particular substratum or locality for investigation. Most of the isolates are of tropical or sub-tropical origin. Organisms received from other sources are indicated by their previous number, or source.

8. *Culture identification numbers*: Many of our cultures have been distributed previously as "PQMD" numbers. The "P" and the "D" have now been dropped and a culture formerly designated as "PQMD *4c*," is now "QM *4c*," i.e., the actual number is unchanged.

Numerous cultures that had been isolated at other agencies and sent to us have been accessioned under our own QM numbers. Where this is the case, our QM number appears first, directly followed by the original culture number. The following categories are those directly concerned with this change:

(a) Cultures isolated at Jeffersonville Quartermaster Depot (4, 5, 6) and sent to us as "JQMD" numbers; for instance *Aspergillus ustus*, JQMD *272*, appears in the present list as "QM *891* (JQMD *272*)."

(b) Cultures isolated by Dr. G. F. Weber at the University of Florida from Quartermaster items exposed experimentally in Florida, listed as "QM *877* (Fla *A–2*)."

(c) Cultures sent to us by Dr. W. H. Weston (14, 15) at Harvard which had been isolated mostly by Dr. E. S. Barghoorn (1, 2) and Dr. W. G. Hutchinson (8) under wartime OSRD contracts. Most of them were made in Panama or were from Panama materials. A culture by Barghoorn appearing in Harvard Reports as "*B–66E*" is here listed "QM *663* (Pan *B–66E*)." Cultures from Hutchinson may be designated as "CZ" or "UP."

(d) BPI = cultures obtained from the Division of Cotton and other Fiber Crops and Diseases, Bureau of Plant Industry, U. S. Department of Agriculture, as "QM *365* (BPI *T–1*)." Cultures in this series have been widely distributed from the Bureau of Plant Industry under such designations as "*T–1*" or "*1334.2*." Recipients have generally added the letters "USDA" as "USDA T–1," etc. Dr. Marsh advises that, with the exception of *Chaetomium globosum*, USDA *1042.4*, all such cultures should be designated "BPI."

(e) AMP = isolates made by the Australian Mycological Panel in 1944; also previously (47) referred to as "Aust." or more commonly as "SN," which translates simply "Serial Number."

(f) MIT = isolates made by W. L. White in 1944 at the Chemical Warfare Service Development Laboratory, Massachusetts Institute of Technology.

(g) 42nd Chem. = isolates made in the southwest Pacific by the 42nd Chemical Laboratory Co. of the Chemical Warfare Service in 1943 and sent to Chemical Warfare Service Development Laboratory, M.I.T.

(h) NIH = National Institute of Health, Bethesda, Md.

(i) NRRL = Northern Regional Research Laboratory, U. S. Department of Agriculture, Peoria, Ill.

(j) BOL = British Ordnance Laboratory, Cawnpore, India.

(k) ATCC = America Type Culture Collection, Washington, D. C.

FUNGI

Organism	*Activity*	*Identified By*	*Substrate*	*Locality*
Absidia capillata van Tieghem (1)				
QM *8b*	C– W–	V. M. Cutter	Cotton shirt	New Guinea
Absidia sp. (1)				
QM *579* (Fla *D-75*)	C– W–		Cot fabric	Florida
Acladium sp.? (2)				
QM *45f*	C+ W+		Shoe	India
QM *49c*	C+ W+		Cartridge belt	India
Acremoniella sp. (1)				
QM *580* (JQMD *454*)	C+ W+	G. W. Martin	Trousers	New Guinea
Acremonium sp. (9)				
QM *1b*	C+ W+		Tent canvas	Bougainville
QM *89c*	C+ W+	W. L. White	Canvas legging	New Guinea

FUNGI (*continued*)

Organism	*Activity*	*Identified By*	*Substrate*	*Locality*
QM *581* (JQMD *365*)	C+ W+	G. W. Martin	Belt	New Guinea
QM *582* (JQMD *1117*)	C+ W+	J. V. Harvey	Tent	New Guinea
QM *583* (JQMD *1168*)	C+ W+	L. G. Isfort	Tent	New Guinea
Acrostalagmus albus Preuss (1)				
QM *663* (Pan *B-66E*)	C+ W+	K. B. Raper	Leaves	Canal Zone
Acrostalagmus cinnabarinus Corda (8)				
QM *320e*	C+ W+	W. L. White	Cardboard	Maryland
Acrostalagmus sp. (1)				
Aegerita sp. (2)				
QM *566* (Pan *B-217I*)	C+ W−	D. H. Linder	Canvas	Canal Zone
Agaricaceae? (1)				
Alternaria oleraceae Milbrath (0)				
QM *280*	C− W+		Tomato transplants	Georgia USA
Alternaria solani (Ellis & Martin) Jones & Grout (0)				
QM *281* (Main Exp. Sta. *52*)	C+ W+		Potato	Maine USA
Alternaria tenuis Nees (14)				
QM *26a*	C+ W+	J. W. Groves	Canvas	Russell Is.
QM *73b*	C+ W+	W. L. White	Plastic canteen	New Guinea
QM *85i*	C+ W+	J. W. Groves	Canvas tent	Italy
QM *120m*	C+ W+	"	Tarpaulin	Canal Zone
QM *584* (Fla *B-7*)	C+ W+	"	Tent	Florida USA
QM *585* (Fla *B-47*)	C+ W+	"	Canvas	Florida USA
QM *586* (Fla *B-48*)	C+ W+	"	Canvas	Florida USA
Alternaria sp. (30)				
QM *15a*	C+ W+	W. L. White	Shoe leather	New Hebrides
QM *298*	C+ W+	M. H. Downing	Electric wiring	Penna. USA
QM *587* (Fla *F-11*)	C+ W+	D. H. Linder	Nylon net	Florida USA
Antennaria sp. (1)				
Aposphaeriopsis n. sp. (1)				
QM *668* (Pan *52A7A*)	C+ W+	D. H. Linder	Canvas	Canal Zone
Arthrobotrys arthrobotryoides (Berlese) Lindau (3)				
QM *669* (Pan *B-63A (II)*)	C+ W−	D. H. Linder	Tentage	Canal Zone
Arthrobotrys superba Corda (1)				
QM *670* (Pan *51A2A*)	C+ W+	D. H. Linder	Textile	Canal Zone
Arthrobotrys superba Corda var. **oligospora** Coemans (1)				
QM *671* (Pan *B-741A*)	C+ W−	D. H. Linder	Tarpaulin	Canal Zone
Arthrobotrys sp. (1)				
Arthrosporium sp. (1)				
Ascobolus saccoboloides Seaver ex Dodge & Seaver (1)				
QM *899* (JQMD *637*)	C+ W+	F. J. Seaver	Socks	New Guinea
Aspergillus awamori Nakazawa (1)				
Aspergillus caespitosus Raper & Thom (1)				
QM *961*	C− W+	Reese & Downing	Shoe	New Guinea
Aspergillus candidus Link (1)				
Aspergillus carbonarius (Bainier) Thom (0)				
QM *331* (NRRL *369*)	C− W−			

FUNGI (*continued*)

Organism	*Activity*	*Identified By*	*Substrate*	*Locality*
Aspergillus chevalieri (Mangin) Thom & Church (16)				
QM *52b*	C− W−	K. B. Raper	Khaki shirt	New Guinea
QM *64c*	C− W−	Reese & Downing	Poplin shirt	New Guinea
QM *112a*	C− W−	W. L. White	Synthetic buttons	Florida USA
QM *312*	C− W−	Reese & Downing	Cork gasket	Penna. USA
Aspergillus chevalieri (Mangin) var. **intermedius** Thom & Raper (4)				
QM *58b*	C− W−	K. B. Raper	Leatherette	New Guinea
Aspergillus clavatus Desmazieres (4)				
QM 862 (JQMD *239*)	C− W+	G. W. Martin	Tarpaulin	New Guinea
QM *872* (JQMD *206*)	C− W+	K. B. Raper	Tarpaulin	New Guinea
Aspergillus conicus Blochwitz (2)				
Aspergillus fischeri Wehmer (9)				
QM *864* (JQMD *589*)	C+ W+	G. W. Martin	Paper	Georgia USA
QM *865* (Fla *A-11*)	C+ W+	K. B. Raper	Canvas cot	Florida USA
QM *866* (Fla *B-21*)	C+ W+	"	Canteen cover	Florida USA
QM *867* (Fla *B-26*)	C+ W+	"	Sample cloth	Florida USA
Aspergillus flavipes (Bainier & Sartory) Thom & Church (10)				
QM *24a*	C+ W−	K. B. Raper	Grey netting	Russell Is.
QM *868* (Fla *A-14*)	C+ W+	"	Canvas cot	Florida USA
QM *869* (Fla *B-67*)	C+ W+	"	Canvas legging	Florida USA
Aspergillus flavus Link (89)				
QM *4m*	C− W+	K. B. Raper	Shoe	Bougainville
QM *10e*	C− W+	"	Canvas	New Guinea
QM *63c*	C− W+	W. L. White	Cotton rope	New Guinea
QM *70a*	C− W+	W. L. White	Shoe	New Guinea
QM *138f*	C− W+		Shoe	New Guinea
QM *380*	C− W+	K. B. Raper	Shoe	New Guinea
QM *870* (Fla *C-2*)	C− W+	K. B. Raper	Web belt	Florida USA
Aspergillus flavus-oryzae group (4)				
QM *871* (Fla *C-57*)	C− W+	K. B. Raper	Sock	Florida USA
Aspergillus foetidus Thom & Raper (0)				
QM *328* (NRRL *341*)	C− W−			
Aspergillus fonsecaeus Thom & Raper (1)				
QM *330* (NRRL *67*)	C− W−			
Aspergillus fumigatus Fresenius (30)				
QM *6b*	C+ W+	K. B. Raper	Shelter half	Bougainville
QM *45h*	C+ W+	"	Shoe	India
QM *445* (MIT *10*)	C+ W+	W. L. White	Chair glue	Mass. USA
QM *497*	C+ W+	E. T. Reese	Compost	Penna. USA
Aspergillus giganteus Wehmer (1)				
QM *620* (Pan *V4CE3AII*)	C+ W−	K. B. Raper	Textile sample	Canal Zone
Aspergillus luchuensis series (36)				
QM *21e*	C+ W−		Tarpaulin	New Hebrides
QM *102d*	C+ W−		Leather liner	New Guinea
QM *155e*	C+ W−	Reese & Downing	Shelter half	New Georgia
QM *873* (JQMD *190*)	C+ W−	G. W. Martin	Tent	New Guinea
QM *874* (JQMD *745*)	C+ W−	"	Tent	New Guinea
Aspergillus melleus Yukawa (2)				
Aspergillus miyakoensis Nakazawa (1)				

FUNGI (*continued*)

Organism	*Activity*	*Identified By*	*Substrate*	*Locality*
Aspergillus montevidensis Talice & Mackinnon (1)				
QM *401* (AMP *81*)	C− W−	D. H. Linder	Electric equipment	New Guinea
Aspergillus nidulans (Eidam) Winter (7)				
QM *25b*	C− W+	Reese & Downing	Shoe leather	Russell Is.
QM *87c*	C+ W+	"	Cotton rope	New Guinea
QM *875* (JQMD *942*)	C− W+	K. B. Raper	Tent rope	Guadalcanal
QM *876* (Fla. *A-13*)	C+ W+	"	Canvas cot	Florida USA
Aspergillus nidulans group (2)				
Aspergillus niger van Tieghem (49)				
QM *458* (TC *215–4247*)	C− W−			
QM *877* (Fla *A-2*	C+ W−	D. H. Linder	Canvas cot	Florida USA
QM *878* (Fla *C-78*)	C− W−		Typewriter ribbon	Florida USA
Aspergillus niger mut. **cinnamomeus** (Schiemann) Thom & Raper (0)				
QM *326* (NRRL *348*)	C− W−	K. B. Raper		
Aspergillus niger mut. **schiemanni** (Thom) Thom & Raper (0)				
QM *327* (NRRL *361*)	C+ W−	K. B. Raper		
Aspergillus niger group (81)				
QM *4j*	C− W−	W. L. White	Shoe	Bougainville
QM *38b*	C− W−	"	Tent canvas	India
QM *45d*	C− W−	"	Shoe	India
QM *50c*	C− W−	"	Tent lines	Hawaii
QM *154a*	C− W−	"	Musette bag	New Georgia
QM *198b*	C− W−	W. L. White	Cotton twill	Eastern USA
QM *386* (AMP *26*)	C− W−	D. H. Linder	Wireless set	Australia
QM *861* (Fla *D-120*)	C− W−	Reese & Downing	Cot fabric	Florida USA
Aspergillus niveus Blochwitz (2)				
QM *879* (JQMD *1148*)	C+ W+	Reese & Downing	Tent	New Guinea
Aspergillus ochraceus Wilhelm (9)				
QM *26b*	C+ W+	W. L. White	Canvas	Russell Is.
QM *58c*	C+ W+	K. B. Raper	Leatherette	New Guinea
QM *880* (JQMD *1014*)	C− W+	"	Mattress cover	Guadalcanal
QM 881 (JQMD *1080*)	C+ W+	L. G. Isfort	Wool overcoat	Guadalcanal
Aspergillus oryzae (Ahlburg) Cohn (3)				
QM *22b*	C− W+	K. B. Raper	Canvas	Russell Is.
QM *82i*	C− W+	W. L. White	Haversack	New Guinea
Aspergillus ostianus Wehmer (1)				
Aspergillus panamensis Raper & Thom (1)				
QM *882* (JQMD *515*)	C− W−	Reese & Downing	Shoe	New Guinea
Aspergillus parasiticus Speare (2)				
QM *883* (Fla *A-7*)	C− W+	K. B. Raper	Cot fabric	Florida USA
QM *884* (Fla *A-8*)	C− W+	"	Cot fabric	Florida USA
Aspergillus phoenicis (Corda) Thom & Currie (0)				
QM *329* (NRRL *1956*)	C− W−	K. B. Raper		
Aspergillus repens (Corda) deBary (22)				
QM *44c*	C− W−		Tobacco	S. W. Pacific
QM *56f*	C− W−	K. B. Raper	Tent rope	New Guinea
QM *59g*	C− W−		Canvas kit	New Guinea

FUNGI (*continued*)

Organism	*Activity*	*Identified By*	*Substrate*	*Locality*
QM *210*	C− W−	W. L. White	Ham	Virginia USA
QM *360*	C− W−	Reese & Downing	Electric wire	Penna. USA
QM *361*	C− W−	"	Electric wire	Penna. USA
QM *364*	C− W−	"	Electric wire	Penna. USA
QM *564*		E. T. Reese	Contaminant	Penna. USA
Aspergillus restrictus G. Smith (6)				
QM *496*	C− W−	E. T. Reese	Wooden stock	Penna. USA
QM *885* (JQMD *1213*)	C− W−	L. G. Isfort	Canvas legging	New Guinea
Aspergillus rugulosus Thom & Raper (0)				
QM *886* (JQMD *729*)	C+ W+	K. B. Raper	Tent	New Guinea
Aspergillus sclerotiorum Huber (2)				
QM *661* (Pan *51A3C*)	C− W+	K. B. Raper	Textile sample	Canal Zone
Aspergillus sulphureus (Fresenius) Thom & Church (3)				
Aspergillus sydowi (Bainier & Sartory) Thom & Church (93)				
QM *4d*	C− W−	K. B. Raper	Shoe	Bougainville
QM *31c*	C− W−	"	Canvas bag	New Guinea
QM *41a*	C− W−	"	Tent rope	India
QM *54a*	C− W−	"	Tentage	New Guinea
QM *96a*	C− W−	W. L. White	Cellophane	Florida USA
QM *103g*	C− W−	Reese & Downing	Canvas tent	New Guinea
Aspergillus tamarii Kita (23)				
QM *50b*	C− W+	K. B. Raper	Tent lines	Hawaii
QM *75b*	C− W+	Reese & Downing	Cellophane	New Guinea
QM *887* (JQMD *949*)	C− W+	K. B. Raper	Shoe leather	Guadalcanal
QM *888* (Fla *A-6*)	C− W+	"	Canvas cot	Florida USA
Aspergillus terreus Thom (53)				
QM *72f*	C+ W+	W. L. White	Leather scabbard	New Guinea
QM *82j*	C+ W+	"	Haversack	New Guinea
QM *91c*	C+ W+	"	Canvas	New Guinea
QM *106g*	C+ W+		Canvas legging	New Guinea
QM *442* (MIT *7*)	C+ W+	W. L. White	Wood shelf	Mass. USA
QM *889* (Fla *B-19*)	C+ W+	K. B. Raper	Canteen cover	Florida USA
Aspergillus unguis Emile-Weil & Gaudin (28)				
QM *8f*	C− W−	K. B. Raper	Cotton undershirt	New Guinea
QM *30b*	C− W−	W. L. White	Shoe	Hawaii
QM *45e*	C− W−	K. B. Raper	Shoe	India
QM *53c*	C− W−	"	Leather strap	New Guinea
QM *890* (Fla *F-8*)	C− W−	"	Nylon hammock	Florida USA
Aspergillus ustus (Bainier) Thom & Church (43)				
QM *29c*	C+ W+	K. B. Raper	Tarpaulin	Hawaii
QM *89d*	C+ W+	W. L. White	Canvas legging	New Guinea
QM *133f*	C+ W−		Canteen cover	New Georgia
QM *137d*	C+ W−		Shoes	New Guinea
QM *891* (JQMD *272*)	C+ W−	G. W. Martin		Indiana USA
QM *892* (JQMD *673*)	C+ W+	Reese & Downing	Case liner	Georgia USA
Aspergillus ustus (Bainier) var. **laevis** Blochwitz (14)				
QM *24a-2*	C− W−	K. B. Raper	Netting	Russell Is.
QM *893* (Fla *F-17*)	C− W−	"	Nylon hammock	Florida USA

FUNGI (*continued*)

Organism	*Activity*	*Identified By*	*Substrate*	*Locality*
Aspergillus versicolor (Vuillemin) Tiraboschi (98)				
QM *4g*	C− W−	W. L. White	Shoe leather	Bougainville
QM *17d*	C− W−	K. B. Raper	Tentage	New Hebrides
QM *432* (MIT *1c*)	C− W−	"	Cellophane	India
QM *894* (Fla *D-77*)	C− W−	"	Cot fabric	Florida USA
Aspergillus versicolor group (2)				
Aspergillus violaceo-fuscus Gasperini (3)				
QM *335* (NRRL *360*)	C− W−	K. B. Raper		
Aspergillus wentii Wehmer (1)				
QM *44a*	C− W−	K. B. Raper	Tobacco	S. W. Pacific
Aspergillus sp. (3)				
Basidiomycetes (48)				
QM *588* (Fla *B-44*)	C+ W−	W. L. White	Canvas	Florida USA
QM *589* (Fla *B-75*)	C+ W+	"	Shoe	Florida USA
Blakeslea trispora Thaxter (12)				
Blakeslea sp. (11)				
Blennoria sp. (1)				
QM *590* (JQMD *991*)	C− W−	G. W. Martin (?)	Nylon plate	Indiana USA
Botryella sp. (3)				
Botryodiplodia theobromae Patouillard (157)				
QM *78a*	C+ W+	W. L. White	Tent canvas	New Guinea
QM *145h*	C+ W+		Tarpaulin	New Georgia
QM *166a*	C+ W+		Citrus	Trinidad
QM *898* (JQMD *891*)	C+ W+	G. W. Martin	Tent	New Guinea
Botryodiplodia sp. (4)				
Botryophialophora sp. (1)				
QM *571* (Pan *V58B3AIII*)	C− W+	D. H. Linder	Textile	Canal Zone
Botryosphaeria sp. (1)				
Botryosporium sp.				
QM *907*	C− W−		Paper	from Dr. Sinden
Botrytis cinerea Persoon (0)				
QM *520*	C+ W−	C. L. Fergus	Poinsettia	Penna. USA
Botrytis sp. (7)				
QM *344*	C+ W−	W. L. White	Green pepper	Penna. USA
QM *578*	C+ W−	E. T. Reese	*Maclura pomifera*	Penna. USA
QM *592* (JQMD *540*)	C+ W+	L. G. Isfort	Tent	New Guinea
QM *594* (JQMD *781*)	C+ W−	G. W. Martin	Tent	Pacific
Brachysporium oosporum (Corda) Saccardo (7)				
QM *665* (Fla *G-128*)	C+ W+	D. H. Linder	Water proof bag	Florida USA
Brachysporium sp. (21)				
QM *38d*	C+ W+		Tentage	India
QM *63b*	C+ W+		Cotton rope	New Guinea
QM *70g*	C+ W+		Shoe	New Guinea
QM *595* (Fla *B-57*)	C+ W+	J. W. Groves	Tent	Florida USA

FUNGI (*continued*)

Organism	*Activity*	*Identified By*	*Substrate*	*Locality*
Byssochlamys sp. (1)				
Cephaliophora tropica Thaxter (1)				
QM *596* (JQMD *956*)	C+ W+	W. L. White	Shoe leather	Guadalcanal
Cephalosporium acremonium Corda (2)				
QM *611* (Pan *B-212C*)	C+ W+	D. H. Linder	Canvas	Canal Zone
Cephalosporium curtipes Saccardo (1)				
Cephalosporium sp. (30)				
QM *107a*	C+ W+		Trousers	New Guinea
QM *124h*	C+ W+		Cotton duck	Canal Zone
QM *127e*	C+ W+		Tarpaulin	New Georgia
QM *597* (JQMD) *297*)	C− W+	G. W. Martin	Tent	New Guinea
QM *598* (Fla *B-5*)	C+ W+	D. H. Linder	Tent	Florida USA
Cephalothecium roseum Corda (1)				
QM *599* (Fla B-50)	C− W+		Canvas	Florida USA
Cephalothecium sp. (5)				
QM *600* (JQMD *380*)	C+ W+	G. W. Martin	Tarpaulin	New Guinea
Cercosporella sp. (1)				
QM *601* (JQMD) *786*	C+ W+	G. W. Martin	Tent	New Guinea
Cercosporidium sp. (1)				
QM *602* (JQMD *257*)	C+ W+	G. W. Martin	Tarpaulin	New Guinea
Chaetodiplodia sp. (1)				
QM *603* (JQMD *197*)	C+ W+		Tent	New Guinea
Chaetomella sp. (1)				
QM *40c*	C+ W+		Canvas	India
Chaetomium atrobrunneum Ames (1)				
QM *626* (JQMD *1041*)	C+ W+	L. M. Ames	Mattress cover	Guadalcanal
Chaetomium cochliodes Palliser (1)				
QM *604* (JQMD *131*)	C+ W+	L. M. Ames		Tropical America
Chaetomium elatum Kunze & Schmidt (9)				
QM *382* (AMP *11*)	C+ W+		Sandbag	Australia
QM *605* (JQMD *776*)	C+ W−	L. M. Ames	Tent	Pacific area
QM *606* (JQMD *1082*)	C+ W−	L. G. Isfort	Wool overcoat	Guadalcanal
Chaetomium funicolum Cooke (31)				
QM *33c*	C+ W−	D. H. Linder	Pistol belt	New Guinea
QM *34d*	C+ W−	W. L. White	Canteen cover	New Guinea
QM *35e*	C+ W−	"	Tent	New Guinea
QM *42a*	C+ W−	L. M. Ames	Cap	India
QM *383* (AMP *12*)	C+ W+	"	Pea seed	Australia
QM *607* (Fla *B-12*)	C+ W−	D. H. Linder	Tent	Florida USA
Chaetomium globosum Kunze (93)				
QM *32b*	C+ W+	L. M. Ames	Tent	New Guinea
QM *38f*	C+ W+	"	Canvas tent	India
QM *85n*	C+ W+	"	Canvas tent	Italy
QM *104a*	C+ W+	"	Rubber boot	New Guinea
QM *459* (USDA *1042.4*)	C+ W+			
QM *608* (Fla *C-12*)	C+ W+	D. H. Linder	Shower curtain	Florida USA

FUNGI (*continued*)

Organism	*Activity*	*Identified By*	*Substrate*	*Locality*
Chaetomium indicum Corda (8)				
QM *46b*	C+ W−	L. M. Ames	Tent rope	India
QM *47c*	C+ W−	"	Wax paper	India
QM *156f*	C+ W−	"	Barracks bag	New Georgia
QM *621* (JQMD *810*)	C+ W−	W. L. White	Tent	New Guinea
Chaetomium spirale Zopf (1)				
QM *622* (JQMD *135*)	C+ W+	G. W. Martin		Tropical America
Chaetomium tortile Bainier (1)				
QM *895* (JQMD *477*)	C+ W+	E. T. Reese	Trousers	New Guinea
Chaetomium velutinum Ames (1)				
QM *623* (JQMD *359*)	C+ W+	L. M. Ames	Tent	New Guinea
Chaetomium n. sp. of Ames (8)				
QM *624* (JQMD *486*)	C+ W+	L. M. Ames	Greenhouse soil	Indiana USA
QM *625* (JQMD *647*)	C+ W−	"	Case liner	Georgia USA
Chaetomium sp. (15)				
QM *145k*	C+ W−		Tarpaulin	New Georgia
QM *155b*	C+ W−		Shelter half	New Georgia
QM *627* (JQMD *1105*)	C+ W+	L. G. Isfort	Wool overcoat	Guadalcanal
Chloridium sp. (2)				
QM *567* (Pan *54A3R*)	C+ W+	D. H. Linder	Textile sample	Canal Zone
Choanophora simsonii Cunningham (1)				
Choanophora sp. (20)				
QM *565* (Pan *10A4B*)		V. M. Cutter	Textile sample	Canal Zone
Chromosporium sp. (2)				
QM *628* (Fla *C-73*)	C+ W+	D. H. Linder	Cotton cord	Florida USA
Circinella spinosa van Tieghem & Le Monnier (0)				
QM *537* (Schneidau *760*; ATCC *9025*)	C− W−			
Circinella sydowi Lendner (1)				
QM *629* (JQMD *672*)	C− W−	V. M. Cutter	Litter	Florida USA
Circinella sp. (1)				
QM *672* (Fla *I-A245*)	C− W−	D. H. Linder	Poplin	Florida USA
QM *902* (Fla *C-13*)	C− W−	E. T. Reese	Shower curtain	Florida USA
Citromyces musae Bainier & Sartory (4)				
Cladosporium herbarum Link (31)				
QM *17b*	C− W+	W. L. White	Tentage	New Hebrides
QM *52a*	C− W+		Khaki shirt	New Guinea
QM *55b*	C+ W−		Leather band	New Guinea
QM *71d*	C+ W+		Canvas glove	New Guinea
QM *120g*	C− W+	W. L. White	Tarpaulin	Canal Zone
QM *121k*	C+ W+	"	Tarpaulin	Canal Zone
QM *122e*	C+ W+	"	Duck	Canal Zone
QM *279a*	C− W−	"	Painted wood	Costa Rica
QM *489*	C− W−	Reese & Downing	Floor	Penna. USA
Cladosporium sp. (73)				
QM *122c*	C+ W+	W. L. White	Duck	Canal Zone
QM *146h*	C− W−		Tarpaulin	New Georgia
QM *236*		W. L. White	Shower curtain	
QM *279b*	C− W−	"	Painted wood	Costa Rica

FUNGI (*continued*)

Organism	*Activity*		*Identified By*	*Substrate*	*Locality*
Clasterosporium sp. (1)					
Coccobolus sp. ? (2)					
QM *534* (Pan *X 23A2A*)	C+	W+	D. H. Linder	Textile	Canal Zone
Coccosporium sp. (0)					
QM *230* (Higinbotham *46-1-4*)	C+	W+			
Colletotrichum sp. (2)					
QM *533* (UP *139A*)	C+	W+		Decayed leaves	Canal Zone
Collonaemella sp. (1)					
QM *568* (Pan *B-C61*)	C+	W+		Leather, cowhide	Canal Zone
Coniothyrium sp. (2)					
Coprinus radians (Desmazières) Fries (1)					
Coprinus sp. (3)					
QM *149e*	C−	W+		Tent	New Georgia
QM *630* (JQMD *351*)	C+	W+	G. W. Martin	Greenhouse soil	Indiana USA
Corynespora sp. (2)					
QM *569* (Pan *B-52BI*)	C+	W+	D. H. Linder	Duck	Canal Zone
Ctenomyces serratus Eidam? (0)					
QM *256* (NIH *1902*)	C−	W+	C. W. Emmons	Bird's nest	England
Ctenomyces sp. ? (7)					
QM *199*	C−	W+	C. W. Emmons	Wool shallie	Penna. USA
QM *287* (BOL *D-381*)	C−	W+	W. L. White	Wool serge	India
QM *774* (JQMD *1070*	C+	W−	"	Tent	New Guinea
QM *845* (JQMD *1277*)	C−	W+	"	Wool overcoat	Guadalcanal
Cunninghamella bertholletiae Stadel (1)					
Cunninghamella blakesleeana Lendner (2)					
QM *631* (JQMD *885*)	C−	W+	V. M. Cutter	Tent	New Guinea
Cunninghamella echinulata (Thaxter) Saccardo (6)					
QM *35c*	C−	W+	V. M. Cutter	Tent	New Guinea
QM *154f*	C−	W+		Musette bag	New Georgia
QM *632* (JQMD *927*)	C	W−	V. M. Cutter	Tent rope	Guadalcanal
Cunninghamella elegans Lendner (8)					
QM *633* (JQMD *181*)	C−	W+	V. M. Cutter	Greenhouse soil	Indiana USA
QM *634* (Fla *B-4*)	C−	W+	D. H. Linder	Tent	Florida USA
QM *635* (Fla *C-88*)	C−	W+	"	Typewriter ribbon	Florida USA
Cunninghamella sp. (5)					
QM *636* (JQMD *1035*)	C−	W+	L. G. Isfort	Canvas cot	Guadalcanal
Curvularia brachyspora Boedijn (6)					
QM *93b*	C+	W+	J. W. Groves	Tarpaulin	New Guinea
QM *637* (Fla *A-19*)	C+	W+	"		Florida USA
QM *638* (Fla *B-8*)	C+	W+	"	Tent	Florida USA
QM *639* (Fla *B-46*)	C+	W+	W. L. White	Tent	Florida USA
Curvularia falcata (Tehon) Boedijn (5)					
QM *77a*		W+	J. W. Groves	Tent	New Guinea
QM *120h*	C+	W+	"	Tarpaulin	Canal Zone
QM *640* (JQMD *590*)	C−	W+	"	Tent	New Guinea

FUNGI (*continued*)

Organism	*Activity*	*Identified By*	*Substrate*	*Locality*
Curvularia fallax Boedijn (2)				
QM *561* (Pan *B-663*A)	C+ W+	D. H. Linder	Textile sample	Canal Zone
Curvularia geniculata (Tracy & Earle) Boedijn (2)				
QM *562* (Pan *C1A4A*)	C+ W+	D. H. Linder	Textile sample	Canal Zone
Curvularia intermedia Boedijn ? (1)				
QM *563* (Pan *B-711A*)	C+ W+	D. H. Linder	Textile	Canal Zone
Curvularia lunata (Wakker) Boedijn (33)				
QM *34b*	C+ W+	J. W. Groves	Canteen cover	New Guinea
QM *120L*	C+ W+	"	Tarpaulin	Canal Zone
QM *641* (JQMD *569*)	C+ W+	"	Raincoat	New Guinea
QM *642* (Fla *D-90*)	C+ W+	D. H. Linder	Cot fabric	Florida USA
Curvularia maculans (Bancroft) Boedijn (8)				
QM *666* (Pan *B-210F*)	C+ W+	D. H. Linder	Textile	Canal Zone
Curvularia sp. (22)				
QM *371d*	C+ W+	White & Downing	Cardboard	Florida USA
QM *535* (Pan *58A8B*)	C+ W+	E. T. Reese	Textile	Canal Zone
QM *643* (JQMD *627*)	C− W+	G. W. Martin	Tent	New Guinea
QM *674* (Pan *81H*)	C+ W+	D. H. Linder	Cotton thread	Canal Zone
Cylindrocarpon album (Saccardo) Wollenweber (1)				
QM *673* (Pan *51C20I*)	C+ W+	C. D. Sherbakoff	Textile sample	Canal Zone
Cylindrocarpon candidum (Link) Wollenweber (1)				
QM *530* (Pan *8B5DI*)	C+ W+	C. D. Sherbakoff	Textile sample	Canal Zone
Cylindrocarpon janthotele Wollenweber (2)				
Cylindrocarpon olidum Wollenweber (0)				
QM *538* (Schneidau *850*; ATCC *6679*)	C+ W+			
Cylindrocarpon soparium n.var. (1)				
QM *557* (UP *151*)	C+ W+	C. D. Sherbakoff	Decaying leaves	Canal Zone
Cylindrocarpon sp. (30)				
Cylindrocephalum aureum (Corda) Bonorden (16)				
QM *523* (Fla E-*9*)	C+ W+	D. H. Linder	Canvas cot	Florida USA
QM *610* (Fla *B-116*)	C+ W+	"	Nylon hammock	Florida USA
QM *644* (Fla *D-158*)	C+ W+	"	Rope	Florida USA
Cylindrocephalum sp. (25)				
Cylindrocladium scoparium Morgan (4)				
Cylindrocladium n. sp. (3)				
Cylindrocladium sp. (3)				
Cylindrophora sp. ? (1)				
Cytospora? sp. (1)				
QM *570* (Pan *B-227C*)	C+ W+	D. H. Linder	Canvas	Canal Zone
Cytosporina? sp. (2)				
QM *713* (Pan *B-209T*)	C+ W+	D. H. Linder	Canvas	Canal Zone
Dactylium dendroides (Bulliard) Fries (1)				
QM *508*	C− W+	E. T. Reese	Agaricus	Penna. USA
QM *513*	C− W+	"	Mushroom bed	Penna. USA
Daedalea quercina Fries (0)				
QM *510* (C. L. Fergus *24780-S*)				

FUNGI (*continued*)

Organism	*Activity*	*Identified By*	*Substrate*	*Locality*
Dematiaceae mycelium non-sporulating (29)				
QM *69d*	C− W−		Canvas	New Guinea
QM *646* (JQMD *890*)	C+ W+	G. W. Martin	Tent	New Guinea
Dematium sp. (2)				
QM *647* (JQMD *1193*)	C+ W+		Tent	New Guinea
Dendrodochium sp. (1)				
QM *714* (Pan *4CA3LI*)	C+ W+	D. H. Linder	Canvas	Canal Zone
Dendryphium sp. (4)				
QM *675* (Fla *H-185*)	C+ W+	D. H. Linder	Cotton socks	Florida USA
Dicoccum sp. (1)				
QM *572* (Pan *CZ131*)	C− W−		Telescope	Canal Zone
Diplodia sp. (3)				
QM *648* (Fla *D-19*)	C+ W+		Cot strap	Florida USA
Diplodiella sp. (1)				
Diplodiopsis sp. (1)				
QM *715* (Pan *7PA4C*)	C− W−		Textile	Canal Zone
Diploplenodomopsis? sp. (3)				
QM *573* (Pan *LI6A2BI*)	C+ W+	D. H. Linder	Textile	Canal Zone
Dothiorella sp. (2)				
QM *676* (Pan *B-200F*)	C+ W+	D. H. Linder	Canvas	Canal Zone
Endoconidiophora n. sp. (1)				
QM *677* (Pan *1TD2F*)	C− W−	D. H. Linder	Textile	Canal Zone
Endoconidium sp. (1)				
Endogloea? sp. (1)				
QM *574* (Pan *X1A1A*)	C+ W+	D. H. Linder	Textile	Canal Zone
Endomyces sp. (3)				
QM *577* (Pan *BC-87*)	C− W−	D. H. Linder	Photo film	Canal Zone
Endomycetales (5)				
QM *678* (Pan *7PA61I*)	C+ W−	D. H. Linder	Textile	Canal Zone
Epicoccum sp. (3)				
QM *284e*	C+ W+	W. L. White	Cardboard	Penna. USA
QM *649* (JQMD *790*)	C+ W+		Tent	New Guinea
Epidermophyton floccosum (Harz) Langeron & Milochevitch (0)				
Epistigme sp. (1)				
Eurotium sp. (2)				
QM *650* (JQMD *1130*)			Tent	New Guinea
QM *651* (JQMD *1250*)			Tarpaulin	Guadalcanal
Exophoma sp. ? (1)				
QM *716* (Pan *V7MA5AII*)	C+ W+	D. H. Linder	Textile	Canal Zone
Fomes pinicola (Fries) Cooke (0)				
QM *511* (C. L. Fergus *24719-S*)	C− W−			
Fusarium acuminatum Ellis & Everhart (1)				
QM *525* (Pan *51A2B*)	C+ W+	C. D. Sherbakoff	Textile sample	Canal Zone
Fusarium avenaceum (Fries) Saccardo (5)				
QM *552* (Pan *C1A5EII*)	C− W+	C. D. Sherbakoff	Textile sample	Canal Zone
Fusarium bulbigenum Cooke & Massee (2)				
QM *553* (Pan *51B6F*)	C+ W+	C. D. Sherbakoff	Textile sample	Canal Zone

FUNGI (*continued*)

Organism	*Activity*	*Identified By*	*Substrate*	*Locality*
Fusarium camptoceras Wollenweber & Reinking (3)				
QM *679* (Pan *B-209D*)	C+ W+	C. D. Sherbakoff	Cotton duck	Canal Zone
Fusarium decemcellulare Brick (7)				
QM *613* (Pan *B-647A*)	C+ W+	C. D. Sherbakoff	Textile sample	Canal Zone
Fusarium diversisporum Sherbakoff (34)				
QM *77g*	C+ W+	C. D. Sherbakoff	Tent canvas	New Guinea
QM *88a*	C+ W+	"	Rope	New Guinea
Fusarium equiseti (Corda) Saccardo (1)				
QM *29a*	C+ W+	C. D. Sherbakoff	Tarpaulin	Hawaii
Fusarium graminum Corda (3)				
QM *680* (Pan *B-25D*)	C− W+	C. D. Sherbakoff	Duck	Canal Zone
Fusarium heterosporum Nees n. var. (1)				
QM *51d*	C+ W+	C. D. Sherbakoff	Tentage	Hawaii
Fusarium javanicum Koorders (41)				
QM *23d*	C+ W+	C. D. Sherbakoff	Rope	Russell Is.
Fusarium javanicum Koorders var. **ensiforme** (Wollenweber & Reinking) Wollenweber (5)				
QM *524* (Pan *B-233AI*)	C+ W+	C. D. Sherbakoff	Canvas	Canal Zone
Fusarium javanicum Koorders var. **radicicola** Wollenweber (8)				
QM *529* (Pan *V51F1B*)	C+ W+	C. D. Sherbakoff	Textile sample	Canal Zone
Fusarium lactis Pirotta & Riboni (1)				
QM *612* (Pan *B65DII*)	C+ W+	C. D. Sherbakoff	Dead leaf	Canal Zone
Fusarium lateritium Nees (5)				
QM *120d*	C+ W+	W. C. Snyder	Tarpaulin	Canal Zone
Fusarium melanochlorum (Caspary) Saccardo (1)				
QM *652* (Fla *A-23*)	C+ W+	C. D. Sherbakoff	Cot fabric	Florida USA
Fusarium merismoides Corda (1)				
QM *555* (Pan *51A4F*)	C+ W+	C. D. Sherbakoff	Textile sample	Canal Zone
Fusarium moniliforme Sheldon (81)				
QM *427* (42nd Chem. *70d*)	C+ W+			India
QM *527* (Fla *E-209*)	C+ W+	C. D. Sherbakoff	Food can	Florida USA
QM *653* (Fla *B-13*)	C+ W+	W. C. Snyder	Tent	Florida USA
QM *654* (Fla. *D-145*)	C+ W+	C. D. Sherbakoff	Rope	Florida USA
Fusarium moniliforme Sheldon var. **anthophilum** (A.Br.) Wollenweber (1)				
QM *717* (Pan *7MB5BII*)	C+ W+	C. D. Sherbakoff	Textile sample	Canal Zone
Fusarium moniliforme Sheldon var. **minus** Wollenweber (2)				
QM *556* (Pan *C1A5EI*)	C+ W+	C. D. Sherbakoff	Textile sample	Canal Zone
Fusarium moniliforme Sheldon var. **subglutinans** Wollenweber & Reinking (1)				
QM *526* (Pan *C1A5EI*)	C+ W+	C. D. Sherbakoff	Textile sample	Canal Zone
Fusarium orthoceras Appel & Wollenweber (4)				
QM *655* (Fla *D-101*)	C+ W+	C. D. Sherbakoff	Cot fabric	Florida USA
QM *681* (Pan *V51F4A*)	C+ W+	"	Textile sample	Canal Zone
Fusarium oxysporum Schlechtendahl (33)				
QM *21c*		C. D. Sherbakoff	Tarpaulin	New Hebrides
QM *23e*	C+ W+	"	Rope	Russell Is.
QM *47e*	C+ W+	W. C. Snyder	Wax paper	India
QM *656* (Fla *B-61*)	C+ W+	"	Tent	Florida USA
QM *657* (Fla *C-8*)	C+ W+	"	Web belt	Florida USA

FUNGI (*continued*)

Organism	*Activity*	*Identified By*	*Substrate*	*Locality*
Fusarium redolens Wollenweber (1)				
QM *682* (Fla *E-13*)	C+ W+	C. D. Sherbakoff	Canvas cot	Florida USA
Fusarium reticulatum Montagne (7)				
QM *658* (Fla *B-14*)	C+ W+	C. D. Sherbakoff	Tent	Florida USA
QM *706* (Fla *D-99*)	C+ W+	"	Cot fabric	Florida USA
Fusarium roseum Link (9)				
QM *38a*	C+ W+	W. C. Snyder	Canvas tent	India
QM *38g*	C+ W+	"	Canvas tent	India
QM *659* (Fla *B-24*)	C+ W+	"	Canteen cover	Florida USA
Fusarium sambucinum Fuckel (1)				
QM *662* (Pan *B-65C*)	C+ W+	C. D. Sherbakoff	Dead leaf	Canal Zone
Fusarium scirpi Lambotte & Fautrey (3)				
QM *660* (Fla *C-75*)	C+ W+	D. H. Linder	Cotton cord	Florida USA
Fusarium scirpi Lambotte & Fautrey var. **compactum** Wollenweber (1)				
Fusarium scirpi Lambotte & Fautrey var. **filiferum** (Preuss) Wollenweber (1)				
QM *528* (Pan *B-52A*)	C+ W+	C. D. Sherbakoff	Cotton duck	Canal Zone
Fusarium scirpi Lambotte & Fautrey var. **longipes** (Wollenweber & Reinking) Wollenweber (3)				
QM *50f*	C+ W+	C. D. Sherbakoff	Tent	Hawaii
QM *398* (AMP *68*)	C+ W+		Tent canvas	New Guinea
Fusarium semitectum Berkeley & Ravenel (7)				
QM *66b*	C+ W+	C. D. Sherbakoff	Web strap	New Guinea
QM *122a*	C+ W+	"	Cotton duck	Canal Zone
Fusarium semitectum Berkeley & Ravenel var. **majus** Wollenweber (21)				
QM *121c*	C+ W+	C. D. Sherbakoff	Tarpaulin	Canal Zone
Fusarium solani (Martius) Appel & Wollenweber (41)				
QM *21d*	C+ W+	C. D. Sherbakoff	Tarpaulin	New Hebrides
QM *745* (Fla *D-102*)	C+ W+	"	Cot fabric	Florida USA
QM *746* (Fla *D-106*)	C+ W+	"	Cot fabric	Florida USA
Fusarium solani (Martius) Appel & Wollenweber var. **eumartii** (Carpenter) Wollenweber (6)				
QM *530* (Pan *8B5DI*)	C+ W+	C. D. Sherbakoff	Textile sample	Canal Zone
QM *554* (Pan *52A3L*)		"	Textile sample	Canal Zone
QM *683* (Pan *B-23*)	C+ W+	"	Canvas	Canal Zone
Fusarium solani (Martius) Appel & Wollenweber var. **martii** (Appel & Wollenweber) Wollenweber (36)				
QM *747* (Fla *D-9*)	C+ W+	C. D. Sherbakoff	Cot strap	Florida USA
QM *748* (Fla *F-28*)	C+ W+	"	Nylon net	Florida USA
Fusarium solani (Martius) Appel & Wollenweber var. **minus** Wollenweber (18)				
QM *127h*	C+ W+	C. D. Sherbakoff	Tarpaulin	New Georgia
QM *749* (Fla *C-13b*)	C+ W+	"	Shower curtain	Florida USA
QM *750* (*Fla B-50*)	C+ W+	"	Cot strap	Florida USA
QM *751* (Fla *F-148*)	C+ W+	"	Pistol belt	Florida USA
Fusarium sec. **Elegans** (15)				
QM *106b*	C+ W+	C. D. Sherbakoff	Canvas legging	New Guinea
QM *120e*	C+ W+	"	Tarpaulin	Canal Zone
QM *752* (Fla *D-70*)	C+ W+	"	Cot fabric	Florida USA
Fusarium sec. **Martiella** (22)				
QM *125b*	C+ W+	C. D. Sherbakoff	Cotton duck	Canal Zone
QM *129g*	C+ W+	"	Tent rope	New Georgia

FUNGI (*continued*)

Organism	*Activity*		*Identified By*	*Substrate*	*Locality*
Fusarium sec. **Sporotrichoides** (1)					
QM *753* (Fla *C-66*)	C+	W+	C. D. Sherbakoff	Socks	Florida USA
Fusarium sp. (57)					
QM *70f*	C+	W+		Shoe	New Guinea
QM *197*	C+	W+	M. H. Downing	Wool	Penna. USA
QM *754* (Fla *D-97*)	C+	W+	C. D. Sherbakoff	Cot fabric	Florida USA
Fusidium sp. (3)					
QM *755* (JQMD *1108*)	C+	W+		Wool overcoat	Guadalcanal
Fusoma sp. (2)					
Galactinia sp. (*Botrytis* stage) (0)					
QM *345* (Korf *SS-3*)	C+	W+	R. P. Korf	Greenhouse soil	New York USA
Gelatinosporium sp. (5)					
QM *684* (Pan *B-212H*)	C+	W+	D. H. Linder	Cotton duck	Canal Zone
Geotrichum sp. (2)					
QM *532* (Fla *F-113*)	C−	W−	D. H. Linder	Hammock, mesh	Florida USA
Gibberella saubinetii (Montagne) Saccardo (1)					
QM *685* (Pan *51A3JII*)	C+	W+	C. D. Sherbakoff	Textile sample	Canal Zone
Gliobotrys sp. (1)					
QM *220*	C+	W+		Canvas bag	
QM *756* (JQMD *924*)	C+	W−	L. G. Isfort	Tent	New Guinea
Gliocladium catenulatum Gilman & Abbott (0)					
QM *177* (NRRL *1093*)	C+	W+	W. L. White		
QM *178* (Brian *222*)	C+	W+			
QM *372* (Brian *224*)	C+	W+			
Gliocladium deliquescens Olsen-Sopp (3)					
QM *169* (BOL *191*)		W+	W. L. White		India
Gliocladium fimbriatum Gilman & Abbott (1)					
QM *560* (Pan *V51B3A*)	C+	W+	K. B. Raper	Textile sample	Canal Zone
Gliocladium glaucum (15)					
QM *559* (Fla *H-163*)	C−	W+	D. H. Linder	O. D. poplin	Florida USA
Gliocladium lignicolum Grove (1)					
Gliocladium penicilloides Corda (9)					
Gliocladium roseum Bainier (43)					
QM *243*	C+	W+	W. L. White		Penna. USA
QM *757* (Fla *B-34*)	C+	W+	D. H. Linder	Cloth	Florida USA
Gliocladium (the species that produces gliotoxin and viridin) (5)					
QM *3a*	C+	W+	W. L. White	Tent rope	Bougainville
QM *170* (BOL *63*)	C+	W+	"	Tent	India
QM *354* (Brian *218*)	C+	W+	"	Greenhouse soil	Jealott's Hill, England
QM *355* (Brian *3*)	C−	W+	"	Soil	Southern Rhodesia
QM *357* (Brian *208*)	C+	W+	"	Manured soil	Jealott's Hill, England
QM *365* (ATCC *9645*; BPI *T-1*)	C+	W+	"		Maryland, USA
QM *758* (JQMD *348*)	C+	W+	"	Belt	New Guinea
Gliocladium sp. (29)					

FUNGI (*continued*)

Organism	*Activity*		*Identified By*	*Substrate*	*Locality*
Gliomastix convoluta (Harz) Mason (11)					
QM *4c*	C+	W+	W. W. Diehl	Shoe	Bougainville
QM *124c*	C+	W+	W. L. White	Cotton duck	Canal Zone
QM *367h*	C+	W+	White & Downing	Cardboard	Florida USA
QM *452* (MIT *16*)	C+	W+	W. L. White	Cotton webbing	Mass. USA
QM *759* (Fla *F-121*)	C+	W+	"	Jungle pack	Florida USA
Gloeosporium sp. (3)					
Gloiosphaera globuligera v. Höhnel (2)					
QM *686* (Fla *H-72*)	C−	W+	D. H. Linder	Coated raincoat	Florida USA
Gloiosphaera sp. (1)					
Graphium rubrum Rumbold (0)					
QM *539* (Schneidau *1600*; ATCC *6505*)	C−	W−			
Graphium sp. (2)					
QM *687* (Fla *F-184*)	C+	W+	D. H. Linder	Socks	Florida USA
Gymnoascaceae (1)					
Haplaria grisea Link (4)					
QM *320k*	C−	W+	W. L. White	Cardboard	Maryland
Haplographium sp. (1)					
Haplosporella sp. (3)					
QM *688* (Fla *E-105*)	C+	W+	D. H. Linder	Food cans	Florida USA
Harknessia sp. (3)					
QM *614* (Pan *B-68A*)	C−	W−	D. H. Linder	Dead leaf	Canal Zone
Helicoma sp. (1)					
QM *760* (JQMD *959*)	C+	W+		Tent	New Guinea
Helicosporium lumbricoides Saccardo (1)					
QM *761* (Fla *B-48*)	C+	W−	D. H. Linder	Cot straps	Florida USA
Helminthosporium sp. (15)					
QM *392* (AMP *44*)	C+	W+	D. H. Linder	Canvas	Australia
QM *762* (JQMD *853*)	C+	W+		Tent	New Guinea
QM *763* (Fla *D-7*)	C+	W+		Cot strap	Florida USA
Hemispora sp. (0)					
QM *322*	C−	W−			From Conant, Duke U.
Herpocladiella sp. (1)					
QM *689* (Fla *G-30*)	C−	W−	D. H. Linder	Haversack	Florida USA
Heterosporium tschawytachii Doty (0)					
QM *540* (*Schneidau 2600*)	C−	W−			
Heterosporium sp. (2)					
QM *70b*	C+	W+		Shoe	New Guinea
QM *764* (JQMD *397*)	C−	W−	J. W. Groves	Trousers	New Guinea
Hormiactella sp. (4)					
QM *765* (JQMD *854*)	C+	W−	L. G. Isfort	Tent	New Guinea
QM *766* (JQMD *1050*)	C+	W+	"	Tent	New Guinea
Humicola grisea Traaen (1)					
QM *228*	C+	W+	E. W. Mason	Compost heap	Penna. USA
QM *498*	C+	W+	"	Compost heap	Penna. USA

FUNGI (*continued*)

Organism	*Activity*		*Identified By*	*Substrate*	*Locality*
Humicola sp. (43)					
QM *34e*	C+	W+	W. L. White	Canteen cover	New Guinea
QM *71c*	C+	W+		Canvas glove	New Guinea
QM *73d*	C+	W+		Plastic canteen	New Guinea
Hypomyces ipomoeae (Halsted) Wollenweber (4)					
QM *767* (Fla *F-86*)	C+	W+	C. D. Sherbakoff	Canteen	Florida USA
Isaria sp. (2)					
QM *4f*	C−	W+	W. L. White	Leather	Bougainville
Karlingia rosea (deBary & Woronin) Johanson (0)					
QM *517* (Haskins *45-7*)	C+	W−	J. S. Karling		
Lasiostroma sp. (1)					
QM *690* (Pan *B-202B*)	C+	W+	D. H. Linder	Canvas	Canal Zone
Lichtheimia regneri (Lucet & Costantin) Vuillemin (1)					
QM *45b*	C−	W−	V. M. Cutter	Shoe	India
Macrophoma sp. (2)					
QM *692* (Pan *C1A3M*)	C+	W+	D. H. Linder	Textile sample	Canal Zone
Macrophomopsis sp. (2)					
QM *693* (Pan *B-721AI*)	C+	W+	D. H. Linder	Textile sample	Canal Zone
Macrosporium sp. (6)					
QM *768* (JQMD *996*)	C+	W+		Tent	New Guinea
QM *769* (JQMD *1057*)	C+	W+		Tent	New Guinea
Memnoniella echinata (Rivolta) Galloway (88)					
QM *1c*	C+	W+	W. L. White	Tent canvas	Bougainville
QM *50d*	C+	W+	"	Tent canvas	Hawaii
QM *72i*	C+	W+	"	Leather scabbard	New Guinea
QM *82d*	C+	W+	"	Haversack	New Guinea
QM *176*	C+	W+		Fabric	India
QM *770* (Fla *B-66*)	C+	W+	D. H. Linder	Canvas legging	Florida USA
QM *771* (Fla *F-141*)	C+	W+	W. L. White	Pistol belt	Florida USA
Metarrhizium anisopliae (Metschnikoff) Sorokin (0)					
QM *192* (NRRL *1945*)	C−	W+	W. L. White	Wire worms	Oregon, USA
Metarrhizium brunneum Petch (0)					
QM *191* (NRRL *1944*)	C−	W+	White, conf. Petch	Wire worms	Oregon, USA
Microascus sp. (2)					
QM *859* (Pan *52B4D*)	C+	W+	D. H. Linder	Textile sample	Canal Zone
Micropera sp. (1)					
QM *684* (Pan *B-804AIII*)	C+	W+	D. H. Linder	Fabric	Canal Zone
Microsporum audouini Gruby (0)					
QM *247* (NIH 243)	C−	W+	H. Kittredge	Scalp	Washington, D.C.
Microsporum canis Bodin (0)					
Microsporum gypseum (Bodin) Guiart & Grigorakis (1)					
QM *196*	C−	W+	S. B. Salvin	Wool	Penna. USA
QM *245* (NIH *235*)	C−	W+	C. W. Emmons	Human face	Maryland USA
Monascus purpureus Went (0)					
QM *541* (Schneidau *9340*; ATCC *6405*)	C−	W−			

FUNGI (*continued*)

Organism	*Activity*		*Identified By*	*Substrate*	*Locality*
Monascus sp. (2)					
QM *85g*	C+	W+		Canvas tent	Italy
Monilia sp. (16)					
QM *772* (JQMD *394*)	C+	W−	G. W. Martin	Blanket	New Guinea
QM *773* (JQMD *753*)	C+	W+	"	Tent	New Guinea
Moniliales (1)					
Monosporium sp. (2)					
Monotospora daleae Mason (0)					
QM *542* (Schneidau *3240*)	C+	W−			
Monotospora lanuginosa (Griffon & Maublanc) Mason (0)					
QM *225* (Reese *14PS*)	C−	W−	E. W. Mason	Hot compost	Penna. USA
QM *226* (Reese *16PS*)	C−	W−	E. T. Reese	Hot compost	Penna. USA
QM *227* (Reese *21*)	C−	W−		Compost heap	Cal. USA
Monotospora sp. (5)					
Mortierella sp. (1)					
QM *695* (Fla *E-72*)	C−	W−	D. H. Linder	Rope	Florida USA
Mortierellaceae (5)					
Mucor fumosus Naumov (1)					
QM *436* (MIT *3B*)	C−	W−		Gas mask	Mass. USA
Mucor genevensis Lendner (1)					
QM *549* (Pan *C1B5FII*)	C−	W+	V. M. Cutter	Textile sample	Canal Zone
Mucor heterosporus Fischer (10)					
QM *615* (Pan B-*213C*)	C−	W−	D. H. Linder	Canvas	Canal Zone
Mucor hiemalis Wehmer (14)					
QM *775* (Fla *D-36*)	C−	W−	V. M. Cutter	Cot strap	Florida USA
Mucor microsporus Namyslowski (1)					
QM *551* (Pan *B-C8*)	C−	W−	V. M. Cutter	Twill	Canal Zone
Mucor mucedo Brefeld (1)					
QM *550* (Pan *B-38DII*)	C−	W−	V. M. Cutter	Tent	Canal Zone
Mucor murorum Naumov (1)					
QM *776* (Fla *C-61*)	C−	W+	V. M. Cutter	Socks	Florida USA
Mucor racemosus Fresenius (4)					
QM *79J*	C−	W−	V. M. Cutter	Shoe	New Guinea
QM *777* (Fla *C-29*)	C−	W−	D. H. Linder	Sewing string	Florida USA
Mucor varians Povah (8)					
QM *778* (Fla *D-52*)	C−	W−	V. M. Cutter	Cot fabric	Florida USA
QM *779* (Fla *D-164*)	C−	W−	"	String	Florida USA
Mucor sp. (11)					
QM *155a*	C−	W−		Tent	New Georgia
QM *490*	C−	W−	E. T. Reese	Egg	Eastern USA
Mucorales, undetermined (3)					
Myceliophthora lutea Costantin (0)					
QM *514*	C+	W−	E. T. Reese	Mushroom bed	Penna. USA
Mycogone perniciosa Magnus (0)					
QM *516*	C−	W−	E. T. Reese	Mushroom bed	Penna. USA
Myrothecium inundatum Tode ex Fries (0)					
QM *206* (Preston *XV*)	C−	W+		*Russula adusta*	England

FUNGI (*continued*)

Organism	*Activity*	*Identified By*	*Substrate*	*Locality*
Myrothecium roridum Tode ex Fries (3)				
QM *188*	C+ W+	W. L. White	Tomato	Mexico
QM *201* (Preston *1*)	C+ W+		*Asclepias* sp.	W. Africa
QM *780* (Fla *B-11*)	C+ W+	W. L. White	Tent	Florida USA
Myrothecium verrucaria (Albertini & Schweinitz) Ditmer ex Fries (10)				
QM *34f*	C+ W+	W. L. White	Canteen cover	New Guinea
QM *70h*	C+ W+	"	Shoe	New Guinea
QM *185*	C+ W+	G. Smith	Canvas shoe	England
QM *460* (BPI *1334.2*)	C+ W+	W. L. White	Cotton bale	Washington, D.C.
QM *781* (Fla *C-35*)		"	String	Florida USA
Myrothecium sp.? (3)				
QM *375*	C+ W+		Chestnut	Penna. USA
Myxofusicoccum sp.? (1)				
QM *575* (Pan *B-210M*)	C+ W+	D. H. Linder	Canvas	Canal Zone
Myxosporium sp. (1)				
Myxotrichella sp. (3)				
QM *782* (JQMD *814*)	C+ W+	G. W. Martin	Tent	New Guinea
QM *783* (JQMD *906*)	C+ W+	"	Tent	New Guinea
QM *784* (JQMD *1183*)	C+ W+	L. G. Isfort	Tent	New Guinea
Nectrioidaceae (1)				
Neosphaeropsis sp. (1)				
QM *616* (Pan *54C2L*)	C+ W−	D. H. Linder	Textile	Canal Zone
Nigrospora sphaerica (Saccardo) Mason (9)				
Nigrospora sp. (5)				
QM *785* (JQMD *428*)	C+ W+	W. L. White	Sock	New Guinea
QM *786* (JQMD *925*)			Tent	New Guinea
Nodulisporium sp. (1)				
Oedocephalum albidum Saccardo (1)				
QM *92a*	C+ W+	W. L. White	Knapsack	New Guinea
Oedocephalum sp.				
QM *904*			Paper	from J. W. Sinden
Oidium sp. (3)				
QM *696* (CZ *60*)	C− W−		Leaf	Canal Zone
Oospora lactis (Fresenius) Saccardo (3)				
QM *787* (JQMD *1242*)	C+ W−	W. L. White	Tarpaulin	New Guinea
Oospora sp. (3)				
Oothecium sp. (1)				
Paecilomyces aureo-cinnamomeum (Biourge) Thom (1)				
QM *536* (Pan *B-C37A*)	C− W−	K. B. Raper	Air	Canal Zone
Paecilomyces varioti Bainier (52)				
QM *10a*	C− W−	W. L. White	Canvas	New Guinea
QM *47d*	C− W−	"	Wax paper	India
QM *72e*	C− W−		Leather scabbard	New Guinea
QM *108e*	C− W−		Shoe	Florida USA
Paecilomyces sp. (5)				
QM *286*	C− W−	W. L. White	Ink	Costa Rica

FUNGI (*continued*)

Organism	*Activity*	*Identified By*	*Substrate*	*Locality*
Papularia arundinis (Corda) Fresenius (2)				
QM *788* (Fla *F-43*)	C+ W+	D. H. Linder	Suspenders	Florida USA
QM *789* (Fla *F-182*)	C+ W+	"	Socks	Florida USA
Papulospora sp. (5)				
QM *790* (JQMD *385*)	C+ W+	G. W. Martin	Soil	Indiana USA
QM *791* (Fla *C-32*)	C+ W+		Sewing string	Florida USA
Pazschkella sp. (1)				
QM *697* (Pan *52B6BII*)	C+ W+	D. H. Linder	Textile	Canal Zone
Pellicularia sp. (2)				
QM *792* (JQMD *1022*)	C+ W+	G. W. Martin	Tent rope	Guadalcanal
QM *793* (JQMD *1032*)	C+ W+	L. G. Isfort	Mattress cover	Guadalcanal
Peltaster sp.? (1)				
QM *617* (Pan *B-766A*)	C+ W−	D. H. Linder	Textile sample	Canal Zone
Penicillium africanum Doebelt (1)				
Penicillium atramentosum Thom (1)				
Penicillium avellaneum Thom & Turesson (1)				
Penicillium baiiolum Biourge (5)				
Penicillium biforme Thom (3)				
Penicillium biourgeianum Zaleski (4)				
Penicillium brevi-compactum Dierckx (11)				
Penicillium brevi-compactum series (6)				
Penicillium carmino-violaceum Dierckx (3)				
Penicillium charlesii Smith (1)				
Penicillium charmesinum Biourge (10)				
Penicillium chrysogenum Thom (25)				
Penicillium chrysogenum series (10)				
Penicillium cinerascens Biourge (9)				
Penicillium citreo-viride Biourge (21)				
Penicillium citrinum Thom (17)				
Penicillium citrinum series (280)				
Penicillium commune Thom (2)				
Penicillium corylophilum Dierckx (9)				
Penicillium cyaneum (Bainier & Sartory) Biourge (10)				
Penicillium decumbens Thom (4)				
Penicillium dierckxii Biourge (1)				
Penicillium digitatum Saccardo (1)				
Penicillium expansum Link (2)				
Penicillium fellutanum Biourge (10)				
Penicillium flavi-dorsum Biourge (9)				
Penicillium fluitans Tiegs (2)				
Penicillium frequentans series (15)				
Penicillium funiculosum series (53)				
Penicillium fusco-glaucum Biourge (2)				
Penicillium griseo-brunneum Dierckx (1)				
Penicillium gladioli Machacek (1)				

FUNGI (*continued*)

Organism	*Activity*	*Identified By*	*Substrate*	*Locality*
Penicillium hagemi Zaleski (1)				
Penicillium herquei Bainier & Sartory (4)				
Penicillium implicatum Biourge var. **aureo-marginatum** Thom (5)				
Penicillium implicatum series (10)				
Penicillium intricatum series (1)				
Penicillium italicum Wehmer (1)				
Penicillium islandicum Sopp (1)				
Penicillium janczewskii Zaleski (2)				
Penicillium janthinellum Biourge (5)				
Penicillium javanicum van Beyma (1)				
Penicillium jenseni Zaleski (1)				
Penicillium lilacinum Thom (15)				
Penicillium luteum Zukal (6)				
Penicillium luteum series (84)				
Penicillium majusculum Westling (1)				
Penicillium melinii? Thom (1)				
Penicillium multicolor Grigorieva-Manoilova & Poradielova (5)				
Penicillium musae Weidmann (1)				
Penicillium namyslowskii Zaleski (1)				
Penicillium nigricans-janczewskii (1)				
Penicillium niklewskii Zaleski (1)				
Penicillium notatum Westling (1)				
Penicillium oxalicum Currie & Thom (2)				
Penicillium paczoskii Zaleski (3)				
Penicillium siemaszki Zaleski (1)				
Penicillium simplicissimum (Oudemans) Thom (20)				
Penicillium soppi Zaleski (1)				
Penicillium spinulosum Thom (3)				
Penicillium spinulosum series (1)				
Penicillium steckii Zaleski (5)				
Penicillium suavolens Biourge (3)				
Penicillium sulfureum Sopp (8)				
Penicillium swiecickii Zaleski (1)				
Penicillium tardum Thom (8)				
Penicillium tardum series (9)				
Penicillium umbonatum Sopp (2)				
Penicillium varians Munk-Wehmer (1)				
Penicillium vermiculatum Dangeard (1)				
Penicillium versicolor Wehmer (1)				
Penicillium vinaceum Gilman & Abbott (1)				
Penicillium virido-albus Sopp (1)				
Penicillium palitans Westling (2)				
Penicillium paxilli Bainier (6)				

FUNGI (*continued*)

Organism	*Activity*	*Identified By*	*Substrate*	*Locality*
Penicillium phaeo-janthinellum Biourge (2)				
Penicillium pinophilum Hedgecock (1)				
Penicillium piscarium Westling (1)				
Penicillium puberulum Bainier (1)				
Penicillium purpurogenum Stoll (9)				
Penicillium purpurogenum series (9)				
Penicillium raciborskii Zaleski (1)				
Penicillium restrictum Gilman & Abbott (1)				
Penicillium roqueforti Thom (3)				
Penicillium roseo-cinnabarinum Biourge (1)				
Penicillium roseo-purpureum Dierckx (7)				
Penicillium rugulosum Thom (7)				
Penicillium sanguifluus series (1)				
Penicillium sanguineum Sopp (3)				
Penicillium sartoryi Thom (2)				
Penicillium waksmani Zaleski (5)				
Penicillium westlingi Zaleski (43)				
Penicillium wortmanni Klocker (6)				
Penicillium sp. (194)				
Periconia circinata (Mangin) Saccardo (0)				
QM *352*	C+ W+	from R. W. Leukel	Roots of dwarf milo	Maryland USA
Periconia pycnospora Fresenius (1)				
QM *794* (JQMD *1137*)	C+ W+	J. H. Miller	Tent	New Guinea
Periconia sp. (1)				
Pestalotia adusta group (1)				
QM *558* (Pan *B-205A*)	C+ W−	D. H. Linder	Canvas	Canal Zone
Pestalotia bicolor Ellis & Everhart (1)				
QM *664* (Pan *B-11c*)	C+ W+	D. H. Linder	Decayed leaf	Canal Zone
Pestalotia copernica (21)				
Pestalotia dichaeta Spegazzini (15)				
QM *698* (Fla *F-176*)	C+ W+	D. H. Linder	Bath towel	Florida USA
Pestalotia palmarum Cooke (1)				
Pestalotia royenae Guba (2)				
QM *531* (Pan *H5F1A*)	C+ W+	D. H. Linder	Textile sample	Canal Zone
Pestalotia virgatula Klebahn (46)				
QM *478* (Pan *57B5D*)	C+ W−	D. H. Linder	Textile sample	Canal Zone
QM *479* (Pan *57B5BII*)	C+ W+	"	Textile sample	Canal Zone
Pestalotia sp. (123)				
QM *2d*	C+ W−	W. L. White	Cotton duck	Bougainville
QM *119b*	C+ W−	"	Canvas	Canal Zone
QM *121L*	C+ W−	"	Canvas	Canal Zone
QM *795* (JQMD *654*)	C+ W−	G. W. Martin	Tent	New Guinea
QM *796* (Fla *C-72*)	C+ W+	D. H. Linder	Cotton cord	Florida USA
Phialophora compactum (0)				
QM *260* (NIH *8605*)	C− W−		Human skin	Puerto Rico

FUNGI (*continued*)

Organism	*Activity*	*Identified By*	*Substrate*	*Locality*
Phialophora fastigiata (Lagerberg & Melin) Conant (0)				
QM *265* (NIH *8705*)	C+ W−	E. Melin	Wood pulp	Sweden
Phialophora jeanselmei (Langeron) Emmons (0)				
QM *270* (NIH *8724*)	C− W−		Hand	New York USA
Phialophora lagerbergii (Melin & Nannfeldt) Conant (0)				
QM *267* (NIH *8707*)	C− W−	E. Melin	Wood pulp	Sweden
Phialophora lingnicola (Nannfeldt) Goidanich (30)				
Phialophora melinii (Nannfeldt apud Melin & Nannfeldt) Conant (0)				
QM *266* (NIH *8706*)	C+ W+	E. Melin	Wood pulp	Sweden
Phialophora obscura (Nannfeldt apud Melin & Nannfeldt) Conant (0)				
QM *268* (NIH *8708*)	C+ W−	E. Melin	Wood pulp	Sweden
Phialophora pedrosoi (0)				
QM *259* (NIH *8603*) ..	C− W−		Human skin	Puerto Rico
QM *261* (NIH *8610*)	C− W−		Human skin	Georgia USA
QM *262* (NIH *8615*)	C− W−		Human skin	Louisiana USA
Phialophora richardsiae (Nannfeldt apud Melin & Nannfeldt) Conant (0)				
QM *263* (NIH *8703*)	C+ W−	E. Melin	Wood pulp	Sweden
Phialophora verrucosa Medlar (0)				
QM *264* (NIH *8704*)	C− W−		Wood pulp	Sweden
QM *269* (NIH *8723*)	C− W−		Human Skin	Missouri USA
Phialophora sp. (1)				
QM *645* (JQMD *289*)	C+ W+		Tent	New Guinea
Phoma pigmentivora Massee (0)				
QM *502*	C+ W+		from R. K. S. Wood	England
Phoma terrestris Hansen ? (13)				
QM *106d*	C+ W+		Canvas legging	New Guinea
QM *120k*	C+ W+		Tarpaulin	Canal Zone
QM *797* (Fla *D-92*)	C+ W+		Cot fabric	Florida USA
Phoma sp. (36)				
QM *13e*	C+ W+	W. L. White	Canvas	New Hebrides
QM *798* (JQMD *655*)	W+	G. W. Martin	Tent	New Guinea
QM *799* (Fla *B-30*)	C+ W+	D. H. Linder	Cloth	Florida USA
Phomaceae (4)				
QM *831* (Reuszer *234*)	C+ W+	Reese & Downing	Cotton duck	Canal Zone
QM *832* (Reuszer *156*)	C+ W+	"	Cotton duck	Canal Zone
QM *857* (Reuszer *281*)	C+ W+	"	Cotton duck	Canal Zone
QM *896* (Romano *3*)	C+ W+	"	Cotton duck	Florida USA
Phomopsis sp. (6)				
QM *699* (Pan *VC2A5B*)	C+ W+	D. H. Linder	Textile sample	Canal Zone
Phycomycete (3)				
Piedraia hortai (Brumpt) Fonseca & Leao (0)				
Placosphaeria sp. (3)				
QM *700* (Pan *B-238F*)	C+ W+	D. H. Linder	Canvas	Canal Zone
Platygloea sp. (1)				
QM *800* (JQMD 1223)	C− W−	G. W. Martin	Tent	New Guinea
Pleurophoma sp. (4)				
QM *701* (Pan *5A7B*)	C+ W+	D. H. Linder	Textile sample	Canal Zone
Pleurophomella sp. (1)				

FUNGI (*continued*)

Organism	*Activity*		*Identified By*	*Substrate*	*Locality*
Polyporus sulfureus (Bulliard) Fries (0)					
QM *509* (Fergus *24681-S*)					
Pseudocoprinus sp. (5)					
QM *801* (JQMD *1060*)	C+	W+	L. G. Isfort	Tent	New Guinea
QM *897* (JQMD *1143*)	C+	W+	J. V. Harvey	Tent	New Guinea
Pullularia pullulans (deBary) Berkhout (140)					
QM *72c*	C−	W+	W. L. White	Leather scabbard	New Guinea
QM *122b*	C−	W−	"	Cotton duck	Canal Zone
QM *279c*	C−	W−	"	Painted wood	Costa Rica
QM *338* (Reese *110*)	C−	W−	"	Rutin	New Jersey USA
QM *802* (JQMD *364*)	C−	W−	G. W. Martin	Belt	New Guinea
QM *803* (Fla *B-37*)	C−	W−	W. L. White	Cloth	Florida USA
Pycnis sp. (3)					
QM *618* (Pan *B-209X*)	C+	W+	D. H. Linder	Canvas	Canal Zone
Pycnodothis sp. (1)					
QM *702* (Pan *52A6CII*)	C+	W+	D. H. Linder	Textile sample	Canal Zone
Pycnosporium sp. (3)					
QM *703* (Pan *B-222D*)	C+	W+	D. H. Linder	Canvas	Canal Zone
Pyrenochaeta sp. (9)					
QM *29b*	C+	W+	W. L. White	Tarpaulin	Hawaii
QM *804* (JQMD *831*)	C+	W+	G. W. Martin	Tent	New Guinea
QM *805* (JQMD *1146*)			L. G. Isfort	Tent	New Guinea
QM *830* (Reuszer *200*)	C+	W+	Reese & Downing	Cotton duck	Canal Zone
Rhinotrichum sp. (2)					
QM *806* (JQMD *395*)	C+	W+	G. W. Martin	Blanket	New Guinea
QM *807* (JQMD *1208*)	C+	W+	L. G. Isfort	Head band	New Guinea
Rhizopus arrhizus Fischer (17)					
QM *46c*	C−	W+	V. M. Cutter	Tent rope	India
QM *187a*	C−	W+	"	Rice	Utah USA
QM *808* (JQMD *538*)	C−	W+		Shoe	New Guinea
QM *809* (JQMD *932*)	C−	W+	V. M. Cutter	Tent rope	Guadalcanal
QM *839* (JQMD *208*)	C−	W+	"	Tarpaulin	New Guinea
QM *500* (42 Chem. *8*)	C−	W−	"	Jungle hammock	New Guinea
Rhizopus nigricans Ehrenberg (10)					
QM *387* (AMP *32*)	C−	W+	D. H. Linder	Wireless set	New Guinea
QM *810* (Fla *C-30*)	C−	W+	"	Sewing string	Florida USA
QM *860* (Fla *C-15*)	C−	W+	"	Shower curtain	Florida USA
Rhizopus oryzae Went & Geerlings (4)					
QM *811* (JQMD *464*)	C−	W+	V. M. Cutter	Sock	New Guinea
Rhizopus sp. (2)					
QM *231*	C−	W−	W. L. White	Wool	Penna. USA
Rhodoseptoria sp. ? (1)					
QM *704* (Pan *B-216A*)	C+	W+	D. H. Linder	Canvas	Canal Zone
Robillarda sp. ? (1)					
QM *576* (Pan *B-206A*)	C+	W+	D. H. Linder	Canvas	Canal Zone

FUNGI (*continued*)

Organism	*Activity*	*Identified By*	*Substrate*	*Locality*
Schizophyllum sp. (1)				
QM *812* (JQMD *1181*)	C− W+	J. V. Harvey	Tent	New Guinea
Sclerotinia fructicola (Winter) Rehm (0)				
QM *282* (Vrg. *38*)	C− W−		Sweet cherry	New York USA
Sclerotinia sclerotiorum (Libert) Massee (0)				
QM *505*	C− W−		from Dr. Shade	
Sclerotium sp. (3)				
QM *93a*	C+ W+		Tarpaulin	New Guinea
QM *103e*	C+ W+		Canvas tent	New Guinea
Scopulariopsis brevicaulis (Saccardo) Bainier (17)				
QM *609* (Pan *BC-3*)	C+ W+	K. B. Raper	Binocular reticule	Canal Zone
QM *813* (Fla *C-28*)	C+ W+	D. H. Linder	Sewing string	Florida USA
QM *814* (Fla *C-35*)	C+ W+	K. B. Raper	Sewing string	Florida USA
QM *815* (Fla *F-90*)	C+ W+	"	Cigarette	Florida USA
Scopulariopsis repens Bainier (3)				
QM *399* (AMP *69*)	C+ W+	D. H. Linder	Canvas	Australia
Sepedonium sp. (4)				
QM *816* (JQMD *645*)	C− W+	G. W. Martin	Case liner	Georgia USA
QM *817* (JQMD *908*)	C+ W−	L. G. Isfort	Tent	New Guinea
Septocylindrium sp. (1)				
QM *667* (Pan *B-654A*)	C− W−	D. H. Linder	Textile sample	Canal Zone
Septomyxa affinis (Sherbakoff) Wollenweber (2)				
QM *40b*	C+ W+	C. D. Sherbakoff	Canvas tent	India
Septonema sp. (1)				
QM *818* (Fla *F-41*)	C+ W+	D. H. Linder	Suspenders	Florida USA
Septoria sp. (2)				
QM *705* (Pan *52B41*)	C+ W+	D. H. Linder	Textile sample	Canal Zone
Sordaria fimicola (Rabenhorst) Cesati & deNotaris (1)				
QM *707* (Pan *4CA10A*)	C+ W+	D. H. Linder	Textile sample	Canal Zone
Sordaria humana (Fuckel) Winter (4)				
QM *819* (JQMD *144*)	C+ W+	J. H. Miller	Textile sample	Columbia
QM *820* (JQMD *1185*)	C+ W+	J. V. Harvey	Tent	New Guinea
Sordaria macrospora Auerswald (1)				
QM *821* (JQMD *1127*)	W+	J. H. Miller	Tent	New Guinea
Spegazzinia tessarthra (Berkeley & Curtis) Saccardo (7)				
QM *371e*	C+ W+	W. L. White	Cardboard	Florida USA
QM *373c*	C+ W+	"	Cardboard	Florida USA
QM *840* (JQMD *657*)	C+ W+	"	Tent	New Guinea
QM *841* (JQMD *935*)	C+ W+	"	Tent	New Guinea
Sphaeropsidales (non-sporulating) (38)				
Sphaeropsis sp. (3)				
QM *46h*	C− W−	W. L. White	Tent rope	India
QM *47a*	C− W−	"	Wax paper	India
QM *104g*	C− W−		Rubber boot	New Guinea
Spicaria sp. (3)				
QM *822* (JQMD *511*)	C− W−	G. W. Martin	Shoe	New Guinea
QM *823* (JQMD *957*)	C− W−	"	Shoe leather	Guadalcanal
QM *824* (JQMD *1036*)	C− W−	L. G. Isfort	Canvas cover	Guadalcanal

FUNGI (*continued*)

Organism	*Activity*	*Identified By*	*Substrate*	*Locality*
Sporochisma sp. ? (2)				
QM *708* (Fla *E-97*)	C+ W−	D. H. Linder	Food cans	Florida USA
Sporocybe sp. ? (1)				
Sporotrichum pruinosum Gilman & Abbott (7)				
QM *168* (*UP-215*)	C+ W−	W. L. White	Photogr. film	
QM *244*	C+ W−	"	Burlap	Penna. USA
QM *303*	C+ W−	"	Burlap	Penna. USA
QM *591* (JQMD *490*)	C+ W−	"	Raincoat	New Guinea
QM *593* (JQMD *545*)	C+ W−	"	Shoe	New Guinea
QM *825* (JQMD *432*)	C+ W−	"	Blanket	New Guinea
QM *826* (JQMD *1214*)	C+ W−	"	Hand band	New Guinea
Sporotrichum schenckii Hektoen & Perkins (0)				
QM *257* (NIH *7109*)	C− W−		Human leg	Guatemala
QM *258* (NIH *7021*)	C− W−		Human arm	S. Africa
Sporotrichum sp. (30)				
QM *89a*	C+ W−		Canvas legging	New Guinea
Stachybotrys atra Corda (20)				
QM *94d*	C+ W+	W. L. White	Trousers	New Guinea
QM *102a*	C+ W+	"	Leather band	New Guinea
QM *134b*	C+ W+	"	Haversack	New Georgia
QM *341* (F. Meehan *637*)	C+ W+	Meehan, conf. White	Pepper seed	Iowa USA
QM *395* (AMP *65*)	C+ W+		Haversack	New Guinea
QM *827* (Fla *B-10*)	C+ W+	W. L. White	Tent	Florida USA
Stachybotrys sp. (7)				
QM *369a*	C+ W+		Cardboard	New Guinea
QM *371b*	C+ W+		Cardboard	Florida USA
QM *900* (Fla *C-10*)	C+ W+		Shower curtain	Florida USA
Stemphylium botryosum Wallroth (0)				
QM *544* (Schneidau *6770*)	C+ W+		Air contaminant	Louisiana USA
Stemphylium consortiale (v. Thümen) Groves & Skolko (5)				
QM *41b*	C− W+	W. L. White	Tent rope	India
QM *147c*	C+ W+	J. W. Groves	Tent	New Georgia
Stemphylium sarcinaeforme (Cavara) Wiltshire (0)				
QM *283*	C+ W−		Red clover	New York USA
Stemphylium sp. (10)				
QM *78b*	C+ W+		Canvas tent	New Guinea
QM *367a*	C+ W+	White & Downing	Cardboard	Florida USA
Stereum sp. ? (1)				
Stilbum sp. (1)				
QM *833* (JQMD *1085*)	C+ W+	L. G. Isfort	Wool	Indiana USA
Stysanus sp. (1)				
QM *834* (JQMD *187*)	C+ W+		Soil	Indiana USA
QM *905*	C+ W+		Paper	From J. W. Sinden
Syncephalastrum elegans Marchal (3)				
QM *709* (Fla *G-13*)	C− W−	D. H. Linder	Suspenders	Florida USA

FUNGI (*continued*)

Organism	*Activity*	*Identified By*	*Substrate*	*Locality*
Syncephalastrum nigricans Vuillemin (3)				
QM *835* (Fla *F-92*)	C− W−	D. H. Linder	Matches	Florida USA
Syncephalastrum racemosum (Cohn) Schroeter (18)				
QM *57a*	C− W−	V. M. Cutter	Leatherette	New Guinea
QM *82b*	C− W−	"	Haversack	New Guinea
QM *836* (Fla *B-23*)	C− W−	D. H. Linder	Canteen cover	Florida USA
Syncephalastrum sp. (12)				
QM *837* (JQMD *349*)	C− W−		Belt	New Guinea
Syncephalis sp. (1)				
QM *838* (JQMD *933*)	C− W+	V. M. Cutter	Tarpaulin	New Guinea
Synsporium sp. (1)				
Thamnidium elegans Link (0)				
QM *545* (Schneidau *8140*; ATCC *8997*)	C− W−			
Thamnidium piriforme (Bainier) Migula (0)				
QM *546* (Schneidau *8148*; ATCC *8992*)	C− W−			
Thielavia sepedonium Emmons (10)				
QM *46a*	C+ W+	C. W. Emmons	Tent	India
QM *47g*	C+ W+	"	Wax paper	India
QM *842* (JQMD *963*)	C+ W+		Tent	New Guinea
Thielavia terricola (Gilman & Abbott) Emmons (6)				
QM *214* (Emmons *5100*; ATCC *1722*)	C+ W+		Soil	Iowa USA
QM *843* (JQMD *1170*)	C+ W+	C. W. Emmons	Tent	New Guinea
Thielaviopsis basicola (Berkeley & Broome) Ferraris (0)				
QM *547* (Schneidau *8500*; ATCC *9853*)	C− W−			New Zealand
Tilachlidium sp. (1)				
QM *619* (Pan *B-218EIII*)	C+ W+	D. H. Linder	Canvas	Canal Zone
Tolypomyria prasina Preuss (1)				
Torula sp. (6)				
QM *216* (BOL *D-45*)	C− W−		Jute canvas	India
QM *217* (BOL *D-150*)	W+		Webbing tape	
Torulina sp. (46)				
QM *710* (Fla *D-51*)	C+ W+	D. H. Linder	Cot straps	Florida USA
Traversoa sp. (1)				
Treleasiella sp. (1)				
QM *711* (Pan *B-816AII*)	C+ W+	D. H. Linder	Textile sample	Canal Zone
Trichoderma viride Harz (363)				
QM *6a*	C+ W+	W. L. White	Shelter half	Bougainville
QM *18a*	C+ W+	"	Tentage	New Hebrides
QM *33a*	C+ W+	"	Pistol belt	New Guinea
QM *46d*	C+ W+	"	Tent rope	India
QM *63d*	W+	"	Cotton rope	New Guinea
QM *844* (Fla *C-55*)	C+	D. H. Linder	Socks	Florida USA
Trichoderma viride Harz var. **Koningii** Oudemans (10)				
Trichoderma sp. (32)				
QM *219* (BOL *D-166*)	C+ W+		Parachute	

FUNGI (*continued*)

Organism	*Activity*	*Identified By*	*Substrate*	*Locality*
Trichophyton mentagrophytes (Robin) Blanchard (0)				
QM *248* (NIH *640*)	C− W+		Human foot	Georgia USA
QM *252* (NIH *666*)	C− W+		Dog	Kansas USA
Trichophyton rubrum (Castellani) Sabouraud (0)				
Trichophyton sulfureum Sabouraud (0)				
QM *249* (NIH *651*)	C− W+		Human scalp	Mexico
Trichophyton tonsurans Malmsten (0)				
QM *251* (NIH *662*)	C− W+	C. W. Emmons	Human scalp	Guatemala
Trichosporium sp. (3)				
QM *846* (JQMD *836*)	W+	L. G. Isfort	Tent	New Guinea
QM *847* (JQMD *1023*)	C+ W+	"	Tent rope	Guadalcanal
Trichothecium roseum Link (3)				
QM *102e*	C− W+		Leather liner	New Guinea
Tritirachium dependens Limber (1)				
QM *4g-2*	C− W−	W. L. White	Leather shoes	Bougainville
Tritirachium roseum van Beyma (4)				
QM *164*	C− W−		Veg. ivory button	Tropics
QM *285a*	C− W−	W. L. White	Kapok pad	Penna. USA
QM *494*	C− W−	Reese & Downing	Cotton & nylon	Ohio USA
Tritirachium sp. (5)				
Tryblidopycnis sp. (1)				
Tubercularia sp. (5)				
QM *848* (JQMD *198*)	C+ W−	G. W. Martin	Tent	New Guinea
Vermicularia section (2)				
QM *712* (Pan *B-607D*)	C+ W+	D. H. Linder	Canvas	Canal Zone
Verticicladium sp. (2)				
Verticillium dahliae Klebahn (0)				
Verticillium malthousei Ware (0)				
QM *515*	C− W+	E. T. Reese	Mushroom	Penna. USA
Verticillium niveostratosum Lindau (1)				
Verticillium sp. (26)				
QM *849* (JQMD *310*)	C− W−		Belt	New Guinea
QM *851* (Fla *B-59*)	C+ W+	W. C. Snyder	Tent	Florida USA
QM *852* (Fla *C-7*)	C+ W+	"	Web belt	Florida USA
Volutella sp. (1)				
Wardomyces anomala Brooks & Hansford (0)				
QM *903* (Illman-*V-135*)	C− W−			
Xenosporium sp. (2)				
Zygodesmus sp. (3)				
QM *853* (JQMD *865*)	C+ W+		Tent	New Guinea
QM *854* (JQMD *1114*)	C+ W+		Tent	New Guinea
QM *855* (JQMD) *1174*)	C+ W+		Tent	New Guinea
Zygorrhynchus moelleri Vuillemin (1)				
QM *856* (Fla *A-29*)	C− W−		Soil sample	Florida USA
Mycelia sterila (523)				
Undetermined (163)				

BACTERIA, ACTINOMYCETES AND YEASTS

Organism	*Activity*	*Identified By*	*Substrate*	*Locality*
Acetobacter suboxydans Kluyver and deLeeuw. (0)				
QM *B1473* Army Medical School *621*				
Actinomyces albus Krainsky (0)				
QM *B1478* Bur. Nutr. & Home Ec., *502*	W+	S. Waksman		
Actinomycete, unidentified (53)				
QM *B76*	C−	H. W. Reuszer	Dyed duck	Canal Zone
QM *B157*	C+	"	Dyed duck	Canal Zone
QM *B642*	C−	"	Blanket	New Guinea
QM *B668*	C−	"	Raincoat	New Guinea
QM *B681*	C−	"	Socks	New Guinea
QM *B814*	C+	E. T. Reese	Tarpaulin	New Guinea
QM *B937*	C−	H. W. Reuszer	Haversack	New Guinea
QM *B957*	C−	"	Cotton rope	New Guinea
QM *B1058*	C−	"	Shoe	New Guinea
QM *B1086*	C+	"	Shoe	New Guinea
QM *B1359*	C+	"	Cot, canvas	Florida USA
QM *B1477*	W+	H. S. Levinson	Wool, buried	Penna. USA
QM *B1479*		M. H. Downing	Wool, buried	Penna. USA
Aerobacillus (*schuylkilliensis*) Eisenberg (0)				
QM *B1461* J. T. Baker Chemical Co. *B-20*		G. M. Eisenberg		
Aerobacter aerogenes (Kruse) Beijerinck (0)				
QM *B1463* (NRRL *B562*)				
Alcaligenes bookeri (Ford) Bergey et al (0)				
QM *B1484* ATCC *9128*	W−			
Alcaligenes faecalis Castellani and Chalmers (0)				
QM *B1483* ATCC *8749*	W−			
Bacillus alvei Cheshire and Cheyne (3)				
QM *B1006*	C−	N. R. Smith	Trousers	New Guinea
QM *B1087*		"	Tent flap	New Guinea
QM *B1105*	C−	"	Shoe	New Guinea
Bacillus amylolyticus Kellerman and McBeth (0)				
QM *B529* N. R. Smith *120*	C−			
Bacillus brevis (Flügge) Migula emend. Ford (13)				
QM *B470*	W+	N. R. Smith	Treated canvas	Canal Zone
QM *B842*	C− W−	"	Tentage	New Guinea
QM *B1080*	C−	"	Shoe	New Guinea
QM *B1334*		"	Elastic covering	Florida USA
Bacillus cereus Frankland and Frankland (112)				
QM *B28*	W−	N. R. Smith	Tent	Canal Zone
QM *B42A*	W+	"	Canvas	Canal Zone
QM *B387*	W+	"	Decayed wood	Canal Zone
QM *B476*	C− W+	"	Tent	Canal Zone
QM *B826*	C− W+	"	Shoe	India
QM *B927*	W−	"	Shoe	New Guinea
QM *B1079*		"	Shoe	New Guinea
QM *B1286*		"	Socks	Florida USA

BACTERIA, ACTINOMYCETES AND YEASTS (*continued*)

Organism	*Activity*		*Identified By*	*Substrate*	*Locality*
Bacillus cereus var. *mycoides* Flügge (57)					
QM *B479*		W+	N. R. Smith	Soil	Colombia
QM *B610*	C−	W−	"	Tarpaulin	New Guinea
QM *B743*	C−	W+	"	Tent	New Hebrides
QM *B825*	C−	W−	"	Shoe	India
QM *B898*	C−	W+	"	Scabbard	New Guinea
QM *B964*		W+	"	Knapsack	New Guinea
QM *B1081*			N. R. Smith	Shoe	New Guinea
QM *B1405*			"		Canal Zone
Bacillus circulans Jordan, emend. Ford (11)					
QM *B353*	C−		N. R. Smith	Canvas	Canal Zone
QM *B629*	C−		"	Belt	New Guinea
QM *B857*	C−	W+	"	Kit, Canvas	New Guinea
QM *B1292*			"	Socks	Florida USA
QM *B1335*			"	Elastic cover	Florida USA
QM *B1376*			"	Cotton bag	Florida USA
QM *B1470* VD Research Laboratory *M-14*			C. McLeod	Produces antibiotic	
Bacillus firmus Werner (13)					
QM *B172*	C−	W−	N. R. Smith	Canvas	Canal Zone
QM *B647*	C−		"	Trousers	New Guinea
QM *B666*		W+	"	Raincoat	New Guinea
QM *B719*	C−		"	Shoe	Guadalcanal
QM *B824*		W−	"	Rope	India
QM *B1124*			"	Tarpaulin	New Guinea
Bacillus firmus-circulans intermediates (5)					
QM *B787*		W−	N. R. Smith	Tentage	Hawaii
QM *B988*	C−	W−	"	Tentage	New Guinea
Bacillus megatherium deBary (188)					
QM *B603*		W−	N. R. Smith	Tent	New Guinea
QM *B705*		W+	"	Tent	New Guinea
QM *B773*		W+	"	Rope	Russell Is.
QM *B793*		W+	"	Canvas bag	New Guinea
QM *B844*	C−	W+	"	Leather	New Guinea
QM *B975*		W−	"	Trousers	New Guinea
QM *B980*		W+	"	Helmet liner	New Guinea
QM *B1193*			"	Rope	Florida USA
QM *B1227*			"	Precoated can	Florida USA
QM *B1276*			"	Shelter half	Florida USA
Bacillus polymyxa (Prazmowski) Migula (4)					
QM *B768*	C−		N. R. Smith	Tarpaulin	New Hebrides
QM *B995*	C−		"	Rubber boot	New Guinea
QM *B1100*	C−		"	Khaki shirt	New Guinea
Bacillus pumilus Gottheil (66)					
QM *B21*		W−	N. R. Smith	Tentage	Canal Zone
QM *B170*		W+	"	Canvas	Canal Zone
QM *B746*		W+	"	Tent	New Hebrides
QM *B803*		W+	"	Pistol belt	New Guinea
QM *B846*		W+	"	Leather	New Guinea
QM *B910*		W+	"	Cover, cellulose	New Guinea

BACTERIA, ACTINOMYCETES AND YEASTS (*continued*)

Organism	*Activity*	*Identified By*	*Substrate*	*Locality*
QM *B1309*		"	Canvas bag	Florida USA
QM *B1383*		"	Cotton socks	Florida USA
Bacillus sphaericus Neide (7)				
QM *B41*		N. R. Smith	Canvas	Canal Zone
QM *B891*	C− W−	"	Shoe	New Guinea
QM *B1118*	C−	"	Tarpaulin	New Guinea
QM *B1152*	C−	"	Suspender straps	New Guinea
Bacillus sphaericus var. *fusiformis* Gottheil (17)				
QM *B784*	C− W−	N. R. Smith	Shoe	Hawaii
QM *B811*	W−	"	Legging	New Guinea
QM *B873*	W−	"	Web strap	New Guinea
QM *B896*		"	Glove, canvas	New Guinea
QM *B1082*		"	Shoe	New Guinea
Bacillus subtilis Cohn, emend. Prazmowski (55)				
QM *B639*	W+	N. R. Smith	Socks	New Guinea
QM *B655*	W−	"	Socks	New Guinea
QM *B742*	C− W+	"	Canvas roll	New Guinea
QM *B778*	W+	"	Grey netting	Russell Is.
QM *B835*	W+	"	Tent lines	Hawaii
QM *B845*	C− W−	"	Leather	New Guinea
QM B922	W+	N. R. Smith	Tent	New Guinea
QM *B942*	C− W+	"	Shoe	New Guinea
QM *B952*	W+	"	Tentage	New Guinea
QM *B1228*		"	Precoated can	Florida USA
QM *B1230*		"	Lacquered can	Florida USA
Bacteria unidentified (435; for the most part gram-negative to gram-variable rods)				
QM *B54*	C+		Tentage	Canal Zone
QM *B123*	C+		Cotton duck	Canal Zone
QM *B142*	C+		Cotton duck	Canal Zone
QM *B230*	C+		Cotton duck	Canal Zone
QM *B240*			Cotton duck	Canal Zone
QM *B275*	C+		Cotton duck	Canal Zone
QM *B283*	C+		Cotton duck	Canal Zone
QM *B318*	C+		Cotton duck	Canal Zone
QM *B319*	C+		Cotton duck	Canal Zone
QM *B1469*			Liquefies cellosize (Hydroxy-ethyl cellulose)	Penna. USA
QM *B1471*			Rhotex-QS L-200 (Rohm & Haas)	Penna. USA
Cellulomonas biazotea (Kellerman) Bergey et al. (0)				
QM *B525* N. R. Smith *127*	C+			
Cellulomonas cellasea (Kellerman and McBeth) Bergey et al. (0)				
QM *B526* N. R. Smith *124*				
Cellulomonas fimi McBeth and Scales (0)				
QM *B527* N. R. Smith *133*	C+			
Cellulomonas flavigena (Kellerman and McBeth) Bergey et al. (0)				
QM *B528* N. R. Smith *134*	C+			
Cellvibrio fulvus Stapp and Bortels (2)				
QM *B18*	C+	W. C. Haynes	Soil	Canal Zone
QM *B102*	C+	"	Cotton duck	Canal Zone

BACTERIA, ACTINOMYCETES AND YEASTS (*continued*)

Organism	*Activity*	*Identified By*	*Substrate*	*Locality*
Cellvibrio vulgaris Stapp and Bortels (11)				
QM *B1*	C+	W. C. Haynes	Duck, in soil	Canal Zone
QM *B2*	C+	"	Duck, in soil	Canal Zone
QM *B4*	C+	"	Duck, in soil	Canal Zone
QM *B6*	C+	"	Muslin	Canal Zone
QM *B8*	C+	"	Soil	Canal Zone
QM *B9*	C+	"	Soil	Canal Zone
QM *B12*	C+	"	Soil	Canal Zone
Cellvibrio sp. (3)				
QM *B89*		H. W. Reuszer	Tarpaulin	Canal Zone
QM *B93*		"	Tarpaulin	Canal Zone
Corynebacterium sp. (12)				
QM *B487*	C+	H. W. Reuszer	Sling, rifle	New Guinea
QM *B493*	C+	"	Tentage	New Hebrides
QM *B503*	C+	"	Leggings	New Guinea
QM *B509*	C+	"	Haversack	New Guinea
QM *B514*	C+	"	Tent	New Guinea
QM *B521*		"	Tent rope	New Guinea
Escherichia coli (Migula) Castellani and Chalmers (0)				
QM *B1457*			Strain for reduction of dihydro-ascorbic acid.	
QM *B1465* J. T. Baker *B-44* (ATCC *9673*)				
Lactobacillus arabinosus Fred, Peterson and Anderson (0)				
QM *B1475* Army Medical School *31-0-1*				
Lactobacillus casei (Orla-Jensen) Holland (0)				
QM *B1474* Army Medical School *31-E-1*				
Lactobacillus fermenti Beijerinck (0)				
QM *B1476* Army Medical School *31-1L-1*				
Micrococcus pyogenes var. *aureus* (Rosenbach) Zopf (0)				
QM *B1458*		G. F. Reddish	FDA strain for phenol coeffi-cient test.	Penna. USA
Micrococcus sp. (23)				
QM *B30*			Tentage	Canal Zone
QM *B296*	C−		Cotton duck	Canal Zone
QM *B398*	C−		Lens	Canal Zone
QM *B454*			Cotton duck	Canal Zone
QM *B821*	C−		Tenting	India
Proteus vulgaris Hauser (0)				
QM *B1464* J. T. Baker *B-31* (ATCC *7246*) W−				
Pseudomonas aeruginosa (Schroeter) Migula (0)				
QM *B1468*	W−	H. S. Levinson	Contaminant on agar plate.	
QM *B1485*		P. Kopper	Creatinine decomposer; no pyocyanin produced.	
Pseudomonas elongata Humm (0)				
QM *B1472*		H. Humm	Agar liquefier. Marine source	
Pseudomonas sp. (1)				
QM *B1482*	W+	H. S. Levinson	Wool	Penna. USA

BACTERIA, ACTINOMYCETES AND YEASTS (*continued*)

Organism	*Activity*	*Identified By*	*Substrate*	*Locality*
Rhodotorula bronchialis (Ciferri and Redaelli) Lodder (0)				
QM *B1480*		T. Sproston	Air contaminant	Vermont USA
Saccharomyces lactis (0)				
QM *B1450*			Bakers' yeast	Bavaria
QM *B1452*			Bakers' yeast	Bavaria
QM *B1454*			Bakers' yeast	Bavaria
Salmonella paratyphi (Kayser) Castellani and Chalmers (0)				
QM *B1459* (ATCC *9150*)		P. C. Norman	Carrier strain	Illinois USA
Salmonella typhosa (Zopf) White (0)				
QM *B1460*			FDA strain for phenol coefficient test.	Penna. USA
Serratia marcescens Bizio (0)				
QM *B1455*			From M. Landy, Wyeth Drug Co.	Phila. USA
QM *B1466* (ATCC 990)				
Sporocytophaga myxococcoides (Krzemieniewska) Stanier (23)				
QM *B482* USDA, Gray's strain	C+			
QM *B490*	C+		Trousers	New Guinea
QM *B492*		H. W. Reuszer	Shoe	New Guinea
QM *B497*	C+	"	Tenting	Italy
QM *B506*	C+	"	Canteen cover	New Guinea
QM *B511*		"	Trousers	New Guinea
QM *B517*	C+	"	Suspender straps	New Guinea
Sporobolomyces salmonicolor (0)				
QM *B1488* ATCC *623*				
Streptococcus lactis (Lister) Löhnis (0)				
QM *B1467* J. T. Baker *B-78* (NRRL *B446*)				
Torula sphaerica (0)				
QM *B1489* ATCC *2504*				
Torula utilis (0)				
QM *B1487* ATCC *8206*				
Trichosporon asteroides (0)				
QM *B1486* ATCC *4155*				

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CLASSIFICATION OF YEASTS FROM THE FERMENTATION OF COMMERCIALLY BRINED CUCUMBERS [1,2]

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During the fermentation of cucumbers in salt brines, a part of the microbiological activity is due to yeasts. Their portion of the fermentation proper is considered gaseous in nature and covers a wide range with respect to brine concentration, the maximum salt tolerance observed under commercial conditions being upwards of 20 to 22 percent by weight. Since a vigorous gaseous fermentation by yeasts in cucumber brines is associated with the production of "bloaters" or hollow cucumber stock, their behavior is of economic importance to the industry. Previous work on the subject has dealt chiefly with population studies. Specifically, these reports have been concerned with the influence of brine concentration (Etchells, 1941; Etchells and Jones, 1943); the addition of organic acids (Jones, *et al*, 1940); the addition of sugar (Veldhuis, *et al*, 1941); and more recently in connection with the amount of fermentation gas evolved and its composition (Etchells, Fabian, and Jones, 1945).

While the above work established that yeasts were associated with cucumber fermentations under conditions typical of the industry, it gave no information as to the species that might be growing in the brines. The present investigation was undertaken with a two-fold purpose; (1) to obtain more specific information on the principal types of yeasts occurring during the gaseous fermentation of salt-stock cucumbers, and (2) to determine whether a definite sequence of yeast types occurred during the period of general yeast activity. Basic information of this nature is of prime importance since only through such studies can suitable brining procedures or control measures be properly developed, with the ultimate objective of placing the cucumber pickling industry in the group of controlled fermentation industries.

Studies of the chiefly oxidative *surface* yeasts, associated with luxuriant scum formation, constitute the bulk of the information known concerning the yeast types present in connection with brined, salted, and pickled vegetables. The latter types are commonly present on the surface of brines exposed to air but sheltered from direct sunlight. At the outset in the present work a clear-cut distinction should be made between the film-forming yeasts and the fermentative *subsurface* yeasts in commercial cucumber brines which are responsible for the gaseous fermentation.

[1] Agricultural Chemical Research Division Contribution No. 236.

[2] This study was carried out under a cooperative project with the Department of Horticulture of the North Carolina Agricultural Experiment Station.

It has been pointed out (Etchells and Jones, 1946; Etchells, Jones, and Lewis, 1947) that conditions permitting active growth of film-yeasts, such as afforded by open containers sheltered from direct sunlight, are not generally favorable for obtaining the best information as to the predominating subsurface yeast flora contributing to the gaseous fermentation. In the present study, 40 of the 42 commercial fermentations in large vats were under outside conditions. Hence, growth of surface scum was controlled by direct sunlight. In the case of the two sheltered vats, film-yeasts were present on the brines but the regular sampling technique (from approximately 6 feet beneath the brine surface) reduced contamination of the subsurface brine samples with film-yeasts to the point where it was no problem. Thus, species of *Debaryomyces*, *Pichia* and *Mycoderma* such as found by Mrak and Bonar (1939) from surface films of various brined foods would not ordinarily be expected in any numbers. This point is substantiated in the data to follow.

INTRODUCTORY STUDIES

During the 1946 brining season a beginning was made on the yeast classification work with 218 isolates which were obtained from 22 unsheltered fermenting vats, the latter being divided equally between two commercial plants (A and B) located in eastern North Carolina. The brining treatments were similar in that the initial concentration employed by both plants to cover the green cucumbers was designed to equalize at about 10 percent. They differed chiefly in the rate of increase of brine strength; plant A increased the brine strength to 15 percent in about 6 weeks, whereas plant B took about one-half that time to reach the same strength. At both plants, the fermentations selected were about 18 to 21 days old and all showed active gas evolution. These vats were sampled only three to four times each during the period from the middle of July until the first week of September. It was intended that this introductory study should give information on how many generic groups might be involved and the possible influence of the two brining treatments on these groups.

It developed that the 218 isolates could be divided into 213 that were asporogenous and 5 that were sporogenous. The asporogenous group was divided into 138 isolates which had small to tiny cells, fermented 3 sugars (glucose, sucrose, and raffinose ⅓), and were strongly nitrate positive; and 75 isolates that were round to oval, fermented both lactose and maltose, and were moderately to weakly nitrate positive. The first group was classified as *Torulopsis* and predominated during the first part of the fermentation; the second group was classified as *Brettanomyces*, and predominated during the latter part. Further, the two groups had one characteristic in common; both were short-lived on slant cultures of ordinary dextrose agar. This fact nearly resulted in loss of the collection of these yeasts. It was first discovered in connection with the tiny-celled type, and a large proportion of the isolates obtained from the brine samples taken during July and

August were dead by the latter part of September. The 75 lactose and maltose fermenters were then inspected and found to be in a very poor state of viability. These were finally revived by adding lactose broth directly to the slant culture. Thereafter, they were kept in 4 percent lactose broth at room temperature with excellent results for periods up to 9 months.

In October 1946, an effort was made to re-isolate the tiny-type *Torulopsis* from the original brine samples of the 22 vats taken during the two samplings of July and August and which had been refrigerated (3–4°C.). This was only partially successful. A possible explanation for this appeared to lie in the fact that 74 of the 75 *Torulopsis* isolates obtained came from the 11 fermentations followed at plant B, where the brines, as compared to those from plant A, had very little acidity. The rapid increase in brine salinity employed at plant B afforded very little opportunity for a fermentation by the lactic acid bacteria. This would indicate that the tiny-cell type *Torulopsis* was sensitive to the brine acid of the plant A samples during storage in the refrigerator.

It was indicated that the sporogenous isolates, classified as *Hansenula* and *Torulaspora*, were obtained less frequently since only 3 cultures of the former genus and 2 of the latter were found.

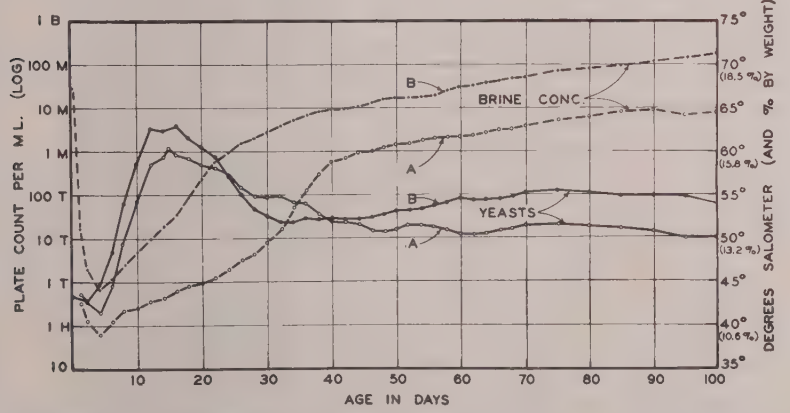

Figure 1. Yeast populations and the increase of brine concentration at two commercial plants (A and B).

EXPERIMENTAL

With the above points in mind, the work for the 1947 season was continued at the two plants mentioned in the 1946 study and included 10 fermentations at each plant. Sampling started shortly after the vats were filled and brined and continued at frequent intervals for approximately 100 days. Individual vats were chosen at random and represented different periods of the season during which cucumbers were being brined. Fer-

mentations occurred for the most part over a period from July until mid-October with brine temperatures within the range of 25 to 27°C., except for the period from mid-September to mid-October when they were 20 to 25°. Eighteen vats were located outside and were unsheltered; two at plant B were sheltered. The brine temperature of the latter two vats averaged about 3° lower than those that were outside. The rate of increase in brine strength employed by each plant, and the resulting yeast populations ob-

TABLE 1. ORIGIN OF 1226 YEAST ISOLATES FROM 20 FERMENTATIONS AT 2 COMMERCIAL PLANTS (1947 SEASON)

PLANT A					
Vat Number (and Date Filled)	Vat Capacity (and cucumber size) [1]		Number of Isolates Obtained Using Glucose Agar		Fermentation Period Covered by Isolations
			Without Salt	With Salt	
	bu.	(*no.*)			*days*
F–161 (7–3)	415	(3's)	40	27	11th to 104th; (16,14) [2]
F–163 (7–3)	425	(3's)	37	26	7th to 76th; (15,15)
F–164 (7–3)	450	(3's)	45	30	7th to 104th; (17,16)
F–167 (7–3)	725	(3's)	40	31	7th to 104th; (15,15)
F–221 (7–6)	475	(3's)	35	28	8th to 101st; (15,14)
F–236 (7–6)	495	(3's)	39	28	8th to 101st; (16,15)
F–287 (7–13)	580	(2's)	25	22	1st to 94th; (14,12)
F–288 (7–13)	320	(3's)	22	20	1st to 94th; (12,10)
F–291 (7–20)	600	(2's,1's)	37	21	1st to 87th; (12,11)
F–10 [3] (7–20)	390	(1's)	21	15	8th to 59th; (9,8)
Sub-total			341	248	
Total			589		

[1] Plant A: No. 1's, small cucumbers up to 1" in dia.; No. 2's, medium, up to 1½" dia.; No. 3's large, above 1½" dia.

Plant B: FR refers to field run cucumbers, ungraded as to size.

Plant A used the National variety; plant B, the Earliest of All.

[2] Figures in parentheses in column represent the number of brine platings on glucose agar without salt and with salt, respectively, from which isolations were made.

[3] Vat emptied by plant before observations were completed.

[4] Vats sheltered from weather; all others in the open.

Vat Number (and Date Filled)	Vat Capacity (and cucumber size) [1]		Number of Isolates Obtained Using Glucose Agar		Fermentation Period Covered by Isolations
			Without Salt	With Salt	
PLANT B					
	bu.	(*no.*)			*days*
21–20 (7–2)	650	(FR)	41	32	8th to 105th; (15,15) [2]
21–21 (7–3)	650	(FR)	36	25	11th to 104th; (15,14)
22–21 (7–3)	610	(FR)	41	24	11th to 104th; (15,12)
1–7 [3] (7–3)	625	(FR)	40	30	4th to 76th; (15,14)
23–3 (7–5)	850	(FR)	35	28	2nd to 102nd; (15,14)
23–4 (7–5)	775	(FR)	42	26	2nd to 102nd; (16,13)
14–10 [4] (7–9)	750	(FR)	42	23	5th to 98th; (16,12)
15–10 [4] (7–9)	1000	(FR)	31	26	8th to 98th; (13,13)
B1–1 (7–19)	620	(FR)	42	20	9th to 88th; (12,10)
B2–13 (7–19)	500	(FR)	31	22	9th to 88th; (12,11)
Sub-total			381	256	
Total			637		

tained, are shown in figure 1. The curves represent mean values for 10 fermentations at each plant.

The brine samples were collected, plated, and counted according to methods previously described by Etchells (1941) and later revised by Etchells and Jones (1946). Two collections of isolates (1,226 in all) were obtained; one from acidified dextrose agar, the other from the same medium containing 8 percent salt by weight. The purpose of the salted medium was to determine whether any types were present that required salt in relatively high concentrations for growth. None, however, was found and the plate counts for the fermentations were essentially the same on either medium. At each plating interval the plates from the high dilutions were set aside for picking representative colonies.

The details concerning the origin of the isolates obtained during the 1947 season are shown in table 1. Of the total number of isolates picked, approximately 48 percent came from the fermentations at plant A, and 52 percent from plant B. In both cases there were fewer isolates picked

from salt agar, since it had originally been intended only to supplement those from the unsalted media as a check against missing any of the halophilic types mentioned. In all but two cases the cultures isolated covered the fermentation period adequately from the standpoint of yeast activity. The exceptions were vat F–10 at plant A, and vat 1–7 at plant B; both were emptied before the last sample could be obtained.

The methods employed and classification systems used were essentially those outlined in the monographs by the Dutch workers, Stelling-Dekker (1931), Lodder (1934), Diddens and Lodder (1942), and Custers (1940). The work of Bedford (1942) was used for the genus *Hansenula*. Also, the excellent review by Henrici (1941) was most helpful, as was the generous assistance of Dr. L. J. Wickerham of the Northern Regional Research Laboratory, U. S. Department of Agriculture.

Certain modifications and additions were made in connection with the taxonomic tests of the Dutch workers. The basal broth for sugar fermentations consisted of peptone 0.5 percent, yeast extract 0.25 percent, and 3 to 4 percent solutions of the test sugars in 15 x 150 mm.-tubes containing 10 x 45 mm.-inserts. In order to determine the status of the raffinose fermentation (⅓ or complete fermentation), both raffinose and melibiose (in 4 percent solutions) were used. Here, owing to cost of these compounds, small 8 x 75 mm.-tubes were used either with a petroleum jelly seal or one of heavy mineral oil. The latter seal was preferred for the slow fermentation characteristic of some of the yeasts encountered. The basal medium used for sugars was also employed for determinations on the utilization of ethyl alcohol (3%). Inoculated and uninoculated basal medium controls were run in all cases.

For the nitrate test, the synthetic medium of Stelling-Dekker was used, but in liquid form fortified with an addition of 0.1 percent of yeast extract, which was necessary as a supplementary source of growth accessory substance for one yeast group (*Torulopsis*). Wickerham (1946) has shown that certain species of yeasts previously recorded as negative for utilization of ammonium sulfate, urea, and asparagine were found to be positive when required amounts of pure vitamins were added. In the present work the test for nitrate reduction was not by growth differential but by the common test for nitrites used by bacteriologists (S. A. B. Manual, 1937). In our opinion, the test as we use it is more satisfactory than the growth test on slants particularly for species where slant growth is ordinarily scant and for those which require a supplementary source of vitamins. The chemical test is not infallible, however, and the precautions outlined in the Manual should be followed, particularly in case of negative results. The test, according to Wickerham (1947), should be repeated at about 2-day intervals of growth to establish maximum nitrite accumulation and to avoid false negatives. The use of both slant and broth cultures for testing has proved very helpful in our hands when nitrate reduction is weak, or nitrite accumulation is of small magnitude.

For the sporulation tests a vegetable juice medium prepared from a

commercially canned product was used.[3] This medium was essentially the same as that originally described by Wickerham, Flickinger, and Burton (1946). We prepare the medium as follows: Equal parts of juice and water are adjusted to pH 6.0 by addition of 10 percent sodium hydroxide. Then, 2 percent agar and 0.4 percent calcium sulfate are added, the mixture is heated to dissolve the agar, tubed, and sterilized at 15 lbs. pressure for 15 minutes. The final pH is usually about 5.8. The medium has a tendency to foam and wet the plugs, but this can be corrected for the most part by placing the racks of tubed media in a boiling water bath for 10 minutes and then autoclaving carefully. The principal difference in the two media is the higher pH (6.8) preferred by Wickerham *et al.* and the addition of a yeast cake. Also, they prefer the use of fresh slants not over 8 hours old.

Early in the present study a test was made using the modified vegetable juice medium and seven other sporulating media, i.e., potato plugs, potato agar, dilute carrot juice agar (McKelvey, 1926), carrot plugs, Gorodkowa's agar, dilute cucumber juice agar, and gypsum slants (Lindegren, 1945). Two *Torulaspora* isloates and 4 *Hansenula* isolates from brines, together with 3 known species of *Saccharomyces* and 2 of *Hansenula*, were tested on each medium. The media were observed at intervals for a period of several weeks. Considering all genera as a group, the vegetable juice medium was considered superior for indicating spore formation; Gorodkowa's was next best. Carrot agar was the best individual medium for the *Hansenula*, but very poor to negative sporulation for these yeasts was obtained on the 2 potato media. However, the potato media proved superior for the *Torulaspora* isolates. The results for the known species were essentially the same in that the vegetable juice was the best single medium. One strain of *S. ellipsoideus* gave poor results on all media used. As a result of this and subsequent tests with known species from the Northern Regional Research Laboratory (Peoria), the vegetable juice agar was adopted as a screening medium for dividing all the brine isolates into sporogenous and asporogenous types. Representatives of the latter types were thoroughly tested, however, on several other media before recording negative results.

The test for mycelium production was made using point inoculations on poured plates of cornmeal agar to which centered cover glasses were applied (Wickerham and Rettger, 1939). The potato medium of Lodder was also tried but the above procedure gave better results. Modifications of Custers' "standard test" were used in detecting acid production in aerobic culture. Several concentrations of suspended chalk in slants and poured plates of both regular glucose agar and a synthetic agar with glucose were tried. The regular glucose agar (used in this and other tests where mentioned) consisted of the following ingredients; Glucose, 2 to 5 percent; yeast extract, 0.25 percent; $K_2H\ PO_4$, 0.1 percent; salt, 0.5 percent; peptone, 0.5

[3] Manufactured by Campbell Soup Co. under the name "V-8." It is probable that other products of essentially the same composition would prove satisfactory.

TABLE 2. SUMMARIZED MORPHOLOGICAL, CULTURAL, AND BIOCHEMICAL CHARACTERISTICS OF 1424 YEAST ISOLATES FROM 42 COMMERCIAL CUCUMBER FERMENTATIONS.

Generic group, species allocation, number of isolates.[1]	Vegetative Cells	Glucose Agar Growth	Glucose Broth Growth
I. *Torulopsis* Berlese A. *T. caroliniana* sp. nov. 717 isolates 49.6%	From veg. juice agar and glucose agar, cells small to tiny, av. 1.5–2 × 3–4μ. Short-oval to egg-shaped and in clusters; some elongated.	White, moist, glistening; secondary colonies along streak. Scant amount of growth. Cells short-lived; death in approx. 3–6 wks. on slants or in broth.	No ring; no film; broth clears rapidly.
B. *T. holmii* (Jörgensen) Lodder 4 isolates 0.3%	Cells predominately short-oval, 3–4 × 4–5.5μ.	Light buff, glistening, practically smooth.	No ring; no film.
II. *Brettanomyces* Kuff. et van Laer A. *B. versatilis* sp. nov. 561 isolates 38.8%	From broth 3–4 × 4–5μ, round to oval, some elongated. On agar slants, generally the same size. Characteristic cell colonies in broth. Ogive cells in old cultures.	Young growth white, glistening, smooth; old cultures develop light pink to lavender color from center. Cells short-lived in slant cultures. Abundant growth.	Ring; no film.
B. *B. sphaericus* sp. nov. 27 isolates 1.9%	Cells predominately round, but also may be slight oval; 3–5μ dia., some slightly larger; clusters of many cells. Ogive cells in old cultures.	White, smooth, glistening, abundant growth.	Ring; no film.
III. *Saccharomyces* (Meyen) Reess Subgenus *Zygosaccharomyces* Barker A. *Z.* sp 50 isolates 3.5%	From broth, cells generally large, mostly oval and in cell colonies. Av. 4–5 × 4.5–7μ; some larger; elongated chains of cells on old media.	White to light cream; dull; irregular; surface gently folded; moderate to abundant growth.	Ring; no film.
B. *Z.* sp. 9 isolates [5] 0.6%			
IV. *Hansenula* Sydow *H. subpelliculosa* Bedford 49 isolates 3.4%	Cells large, round, oval, sausage-shape, irregular; 6 × 8μ, some elongated. Clusters of several cells.	White, smooth, moist, glistening, abundant growth; discolors with age.	Ring; very slight film.
V. *Torulaspora* Lindner *T. rosei* Guillermond 6 isolates 0.4%	Cells predominately round to slight oval, 3–6μ dia., mostly 4.5μ. Clusters of three to four cells.	White, smooth, glistening, abundant growth. Some strains with granular surface.	Ring; no film.
VI. *Kloeckera* Janke *K. magna* (De 'Rossi) Janke 1 isolate 0.1%	Young cells, oval or apiculate, 3–6 × 5–12μ singly or pairs.	Grey, thin, moist, glistening, smooth; transparent wavey edges.	No ring; no film.

Growth in Ethyl Alcohol	Nitrate Assimilation	Action on Sugars		Ascospore Production	Outstanding Characteristics
		Fermented	Not Fermented		
Absent	Strongly positive	Glucose (2)[2] Sucrose (3) Raffinose (2)	Maltose Galactose A [3] Lactose Melibiose	Not found on 8 sporulation media observed over period of several months.	Small cell size; short-lived nature; strong nitrate test; rapid fermentation; scant amount of growth; characteristic colony formation.
Moderate	Negative	Glucose (2) Sucrose (2) Galactose (2) Raffinose (2)	Maltose Lactose Melibiose	Not found on sporulation media observed over period of several months.	Rapid fermentation of glucose, sucrose, galactose, and raffinose (1/3); short, oval cells.
Good growth with ring; no film.	Positive	Glucose (4) Sucrose (6) Maltose (5) Galactose (8) Lactose (8) Raffinose (12) Melibiose (12)		Not found on 8 sporulation media observed over period of several months.	Fermentation of maltose, lactose, and melibiose; usually a slow, prolonged fermentation behavior; death of cells in aerobic culture due to acid production; high salt tolerance.
Moderate growth with ring; no film.	Positive (latent)	Glucose (7) Maltose (12)	Sucrose A Galactose A Lactose Raffinose Melibiose	Not found on sporulation media observed over period of several months.	Predominately round cells; slow, prolonged fermentation of glucose and maltose; vigorous assimilation of galactose; high salt tolerance; death of cells in aerobic culture.
Moderate growth with ring after one month.	Negative	Glucose (3)	Sucrose [4] A Maltose [5] Galactose A Lactose Raffinose A Melibiose	Positive; isogamic or heterogamic conjugation; 1–3 spores per ascus. Av. spore 3 × 4.5μ; round to oval.	Limited fermentation power; variable action on sucrose in low concentrations; typical sporulation; high salt tolerance.
Moderate growth with ring; no film.	Positive	Glucose (3) Sucrose (3) Raffinose (7)	Maltose [6] A Galactose A Lactose Melibiose	Positive; usually hat-shaped spores, 1–4 per ascus; spores mostly 2 × 3μ; occasionally round spores, 3μ dia.	Lack of significant film formation; vigorous galactose assimilation; variable action on maltose; typical sporulation.
Moderate growth with very slight ring; no film.	Negative	Glucose (1.5) Sucrose (1.5) Raffinose (1.5)	Maltose Galactose Lactose Melibiose	Positive; conjugation tubes formed prior to spore formation, but no conjugation. Spores smooth, round, 1–4 per ascus, 3–4μ dia.	Formation of long conjugation tubes and absence of distinct evidence of conjugation; 1–4 characteristic spores, with oil drop.
Negative	Negative	Glucose	Sucrose Maltose Galactose Lactose Raffinose Melibiose	Not found on several sporulation media.	Apiculate cells and very strong acid production, exceeding the *Brettanomyces*.

[1] Percentages shown on basis of total isolations made (1444); 20 isolates (1.4%) remain not fully classified but include 3 isolates of *Candida*, 4 of *Endomycopsis*, and 1 atypical *Torula spora*. Also, totals include 218 cultures from 1946 season in the following groups: IA, 138; IIA, 75; IV, 3; V, 2.

[2] Numbers in parentheses refer to approximate age in days for maximum gas in insert.

[3] Assimilation of compound.

[4] Action on sucrose variable ranging from none to a latent fermentation.

[5] Nine of 59 isolates ferment maltose strongly in 3 days and apparently belong to a different species.

[6] Action on maltose variable, ranging from no fermentation to a latent, weak fermentation.

percent; and agar, 1.5 percent. The synthetic medium was the same as that used by Stelling-Dekker except it contained 0.01 percent yeast extract.

The most clear-cut results were obtained with poured plates of chalk glucose agar receiving a 2 mm. spot inoculation of the test yeast. At least two levels of chalk suspension, i.e., about 0.5 and 0.8 percent, were found to be helpful in determining the degree of acid production indicated by the cleared zone around the yeast growth. In preparation, the finely ground chalk should be kept in suspension and the plates poured just short of the agar solidification point.

RESULTS

The characteristics of the genera found during the 2-year study are shown in table 2. Column 1 of this table gives summarized data on the predominance of individual species.

Predominating Genera

The predominant genera found fall into the following groups: (1) genus *Torulopsis*; (2) genus *Brettanomyces*; (3) genus *Saccharomyces*, subgenus *Zygosaccharomyces*; (4) genus *Hansenula*; (5) genus *Torulaspora*; (6) genus *Kloeckera*; plus an initial group, genera *Rhodotorula* and *Debaryomyces*, and an unclassified group of 20 isolates.

Group I, Genus *Torulopsis*: Of the 721 cultures isolated in this group, four were identical to *T. holmii* (Jörgensen) Lodder and require no further discussion. The remaining isolates were a homogenous group having small to tiny cells, which ferment glucose, sucrose, and raffinose (⅓) rapidly, are short-lived, strongly nitrate positive, and apparently sensitive to the acid they produce. On chalk-containing media definite acid production is observed. They are rather tolerant of solutions of high osmotic pressure as indicated by rapid growth and gas production in broth containing 40 and 60 percent by weight of sucrose. In laboratory tests their tolerance to salt is > 15 but < 20 percent by weight. Their tolerance in cucumber brines is probably slightly above 15 percent.

These yeasts have certain characteristics in common with the three species isolated by Kroemer and Krumbholz (1931) and described in detail by Krumbholz (1931) as the "small-celled osmophilic *Saccharomyces*" which were identified as *S. stellatus*, *S. bacillaris*, and *S. granulatus*. Later, Lodder (1934) reclassified the first two as *Torulopsis stellata* and *T. bacillaris*, but did not mention the status of *S. granulatus*. We have been unable to locate a culture of this species either in this country or abroad.[4] Krumbholz describes *S. granulatus* as very small and short-lived; but it cannot be definitely identified with our group of isolates since he did not report on response to the nitrate test; nor did he find growth in raffinose, although dextrose and sucrose were fermented. Both *T. stellata* and *T.*

[4] Later, in June 1948 Miss N. J. W. van Rij of the CBS advised us that they had requested this yeast from Krumbholz shortly after his paper was published but the culture had died.

bacillaris ferment the same sugars as our isolates but are nitrate negative as recorded by Lodder (and confirmed by us in repeated tests) and would be eliminated on this count alone.

Although it appears that a definite relationship exists between the two small-celled osmophilic species of Kroemer and Krumbholz and the small-celled brine isolates, the relationship is not sufficient to prohibit species separation. Hence, we propose to place our isolates as *Torulopsis caroliniana* sp. nov.[5]

Group II, Genus *Brettanomyces*: The isolates placed in this genus consisted of 561 that fermented all seven test sugars (including lactose and maltose) and 27 that fermented only two, glucose and maltose. This second group are nearly spherical in shape (with a tendency for ogive shape in old cultures) and the fermentation of the two sugars is very slow. Also, they are inclined to be short-lived on slant cultures and death is presumably due to acid production as indicated by clearing of chalk agar. The nitrate test, however, is generally weak and latent, appearing after about 10 days on slant cultures. This point, plus the absence of any pseudomycelium, may appear to raise a question as to the allocation of this group to the *Brettanomyces*; but neither of these characteristics is considered critical by Custers (1940) in his thorough study of the genus. The fact also that they were obtained during the latter stage of fermentation (from six vats at plant B only, 1947) when the other *Brettanomyces* species was present, is an additional strong point in favor of their inclusion in this genus. They will be therefore considered as such for the present under the proposed name of *Brettanomyces sphaericus* sp. nov.

The group of 561 cultures that fermented all seven sugars was similar to *B. claussenii* Custers; differing in that they fermented raffinose and melibiose (equivalent to complete raffinose). They differed also, in that the cells were round to oval as compared to the more elongated cells of

[5] Since completion of the present investigation, a culture labelled *Torulopsis lactis-condensi* (Hammer) was received from the "Centraalbureau." It was isolated by Hammer in 1919, from gassy sweetened condensed milk. Our study of this yeast showed, in part, that it was inclined to be small-celled, and fermented glucose, sucrose, and raffinose rapidly (1 to 2 days). Furthermore, it reduced nitrate very strongly. The fermentation of raffinose was somewhat surprising in view of the negative test reported by Olson and Hammer (1935) in a redescription of the original characteristics (Hammer, 1919) for *Torula lactis-condensi*. The nitrate reduction test had not been used in either study. Thus a close relationship undoubtedly exists between this yeast and our *Torulopsis caroliniana* sp. nov. However, the cells of *T. lactis-condensi* are distinctly larger than those of our isolates and have a somewhat different shape and internal appearance. Furthermore, *T. lactis-condensi* resembles *T. caroliniana* only to a limited degree in respect to being short-lived on both liquid and solid media (including chalk agar); nor is *T. lactis-condensi* critical in this property with respect to usual cultivation methods. These differences seem sufficient to separate the two yeasts, and this would be in keeping with accepted yeast classification methods in practice today (Stelling-Dekker, Lodder, Diddens and Lodder, Custers). Possibly further study of other isolates of *T. lactis-condensi* from condensed milk (other than the CBS culture) would indicate the exact extent of the similarity between the two yeasts. However, additional strains do not appear to be available here or abroad (Wickerham, 1948).

B. claussenii. The *Brettanomyces* from brine origin were extremely salt-tolerant, as might be expected from their appearance in the fermentation at a time of high brine strength. In laboratory tests they grew on solid media containing 24 percent salt by weight. Fermentation in a 60 percent sucrose solution was also better than in a 40 percent solution, although there was much more cell growth in the latter. Tests on cornmeal agar did not reveal the presence of pseudomycelium for the isolates tested, and essentially the same results were obtained when *B. claussenii* (NRRL 1414) was used. The pseudomycelium for *B. claussenii* in the illustration by Custers shows it to be extremely poorly developed. Yet the brine isolates showed even less. Strong acid production by the *Brettanomyces* on slant cultures is given considerable taxonomic weight by Custers. This characteristic was thoroughly studied on glucose media with different concentrations of chalk suspended in the agar. All the yeast genera found in brines as well as the four known species of *Brettanomyces* were tested for acid production. In brief, it was observed that the known *Brettanomyces* (*B. bruxellensis*, *B. lambicus*, *B. anomalus*, and *B. claussenii*) species as reported by Custers are very strong acid producers; however, this characteristic is not restricted to them alone. The lone *Kloeckera* species from brine was more active. Also, other genera from brines (*Torulopsis* and *Hansenula*) were good chalk-clearers at the 0.5 to 0.8 percent suspension level. The *Brettanomyces* isolates from brine likewise produced acid as indicated by the zone of chalk cleared, but were not equal to the four known species.

To our knowledge this is the first time that yeasts of the genus *Brettanomyces* have been obtained and described from sources other than European breweries. In his thorough study of the genus *Brettanomyces*, Custers found that all but one of the 17 strains collected were of brewery origin. The exception was an isolate obtained from fermenting grape must, reidentified by him as *B. bruxellensis*. There was no indication that the genus had been isolated outside of Europe. There is the possible exception of a single isolate from 31° Balling sirup reported by Bedford (1942) as *B. bruxellensis*. Bedford did not describe the isolate which was incidental to a thorough study of the *Hansenula* genus, and attached no significance to its occurrence. A study of his thesis (Bedford, 1941) shows several characteristics that make his placing of the isolate as *B. bruxellensis* questionable. Since Bedford's culture was presumably no longer living (Mrak, 1948) no comparison could be made with our CBS culture of *B. bruxellensis*.[6]

The fermentation reactions and different morphology of the *Brettanomyces* isolates from high-salt brines during the latter portion of the fermentation is considered sufficient basis for species separation from *B.*

[6] Later, however, we were informed by Wickerham (1948), who was one of the reviewers of this paper, that Bedford's isolate was in his collection. He stated that it does not belong in *Brettanomyces*, but is a species closely related to *Torulopsis utilis*. We are inclined to accept Wickerham's classification of Bedford's isolate as being correct.

claussenii. The name *Brettanomyces versatilis* sp. nov. is suggested. Two *Brettanomyces* isolates, Y-207 and Y-232, were found during the 1946 study that were characterized by growth but no fermentation of sucrose in low concentrations; however, both raffinose and melibiose (complete raffinose) were fermented and in other respects they were similar to the main group. For the present they are considered as variations of *B. versatilis* sp. nov.

Group III, Genus *Saccharomyces*, subgenus *Zygosaccharomyces*: The 59 isolates in this genus were divided into two groups; A, 50 that fermented glucose, but gave a variable action on sucrose; and B, 9 that fermented glucose, sucrose, and maltose. Growth in sucrose media prior to making the test did not appear to influence the results for the Group A isolates; nor did the use of 10 percent sucrose solution instead of the 4 percent solution regularly used. Whereas the 10 and 20 percent solutions of sucrose gave good growth but no gas, the 40 and 60 percent solutions were fermented. This indicated an osmophilic relationship for the action on sucrose. Growth in salt media was within the range of 20 to 24 percent by weight. Group B yeasts were not tested for salt tolerance on laboratory media, but their growth in the fermenting brines at about 18 percent is ample proof of their ability to withstand high osmotic pressures. The *Zygosaccharomyces* are well known for their tolerance toward solutions of high osmotic pressure, particularly those containing sugar, such as honey, maple syrup, and concentrated grape musts. This subject has been adequately reviewed by Henrici (1941). Their tolerance to high salt brines, however, does not appear to be so well established. (Cf. Addendum.)

In an attempt to place the yeasts of Group A as to species, a compilation of the detailed characteristics of some 25 known species was prepared. About one-half of these fell into the "weakly fermentative" class. Species separation appeared to be based on such minor differences that it appeared that continued attempts would further complicate an already confused picture. For this reason, our *Zygosaccharomyces* will be listed merely as species A and B until a satisfactory taxonomic examination of the described species is made by workers in this field. The new culture list by the "Centraalbureau" (CBS, 1947) names 50 species, 8 of which have synonyms; undoubtedly there are more than this conservative number.

Group IV, Genus *Hansenula*: The 49 isolates placed in this genus were characterized by the fermentation of glucose, sucrose, and raffinose (⅓); a variable maltose fermentation; a vigorous galactose utilization; and either extremely thin film production or no film at all. These characteristics (supplemented with the rest shown in table 2) are similar, but not identical, to the species *H. subpelliculosa* Bedford. The variable fermentation of maltose is not entirely consistent; but out of 11 cultures studied by Bedford, one did not ferment this sugar. In a test of an additional 136 cultures by us obtained from refrigerated brine samples (which are not included in our present total of *Hansenula* isolates), 58 fermented maltose in varied degrees while 78 did not. As to utilization of galactose, Bedford had 6 out

of 11 cultures that gave a negative test in a synthetic medium. We are inclined to believe that the fermentation of maltose could well be considered a weak characteristic for the species, providing a sufficient number of cultures are studied. It is obvious that galactose utilization is variable for Bedford's isolates; hence, we believe that for the present no sound basis exists for separating our isolates from the species *Hansenula subpelliculosa* Bedford. For this reason, the 49 isolates listed in table 2 and the 136 obtained from refrigerated brine samples are placed in that species. Representative isolates fermented 60 percent sucrose, and on laboratory media tolerated between 20 and 24 percent salt by weight. When compared to the pseudomycelium produced by *H. anomala*, that produced by the brine *Hansenula* appeared insignificant.

Group V, Genus *Torulaspora*: The 6 cultures of this genus were considered identical with *T. rosei* Guillermond. Four characteristic spores per ascus were frequently found on vegetable juice agar although this important characteristic is not mentioned for the species by Stelling-Dekker. Any redescription of this yeast should include this observation on sporulation. A single culture of *T. rosei* was isolated from grapes by Mrak and McClung (1940), but otherwise it appears not to have been found in this country. The salt tolerance for the brine isolates was between 15 and 20 percent. Rapid growth and fermentation of 40 and 60 percent sugar solutions was obtained.

Group VI, Genus *Kloeckera*: A single culture similar to *Kloeckera magna* (De 'Rossi) Janke was obtained. As previously mentioned, this yeast produced more acid in aerobic culture, using a chalk agar, than any of the four known species of *Brettanomyces*. This was found to be true at different levels of chalk suspension (approx. 0.5, 0.8, and 1.6 percent). Mrak *et al.* (1942) demonstrated that an isolate of *Kloeckera africana* (and one of *Hansenula anomala* var. *sphaerica*) clarified slants of Custers' chalk media more readily than did species of other genera (*Pichia*, *Hanseniaspora*, *Candida*, *Torulopsis*) isolated from figs.

Initial Group, Genera *Rhodotorula* and *Debaryomyces*: Earlier work (Etchells, 1941; and Etchells and Jones, 1943) has shown that the beginning of active yeast development in cucumber brines of about 10 percent strength starts in about 1 week. It was also shown that the initial yeast populations present at the time the vats are filled and covered with brine drop to extremely low numbers during the first few days prior to active development. In the present study, it had been planned to investigate the initial flora at the time the vats were filled and brined. This would be termed the "initial" plating at "0" days. This portion of the study was not fully realized for two reasons; (1) such vats were not always available at both plants, and (2), more important, there was a high incidence of molds in most of the initial brines sampled, making the plates useless for picking colonies, although after the first few days the molds are no longer found. Of the 7 vats that were sampled initially, only 3 had plates (salt

agar only) that were at all suitable for picking. Twelve isolates were picked. Of the 9 placed generically, 4 were classified as *Rhodotorula* and 5 as *Debaryomyces*. Representatives of these genera were not obtained again throughout the study of the 20 fermentations. (The above yeasts have not been included in the total number of isolates since they represent initial values for only 3 of the 20 vats studied and were obtained from only one plating medium.)

Unclassified Group: Twenty isolates were obtained which have not yet been fully classified. Although they have been studied rather thoroughly, some do not fit into known species descriptions, for one reason or another. Some segregation of the group, however, can be made. Seven of the isolates are film yeasts, four of which were taken from the heavy surface film of the two sheltered vats followed at plant B and properly should be excluded from this study. All of the film yeasts produced well developed pseudomycelium and four appear to have a mixture of both true and pseudomycelium. The latter 4 have been classified as *Endomycopsis*. The remaining three film yeasts, which came from 1- to 2-day-old samples, appear to fall in the genus *Candida*. The finding of four isolates classified as *Endomycopsis* is significant because heretofore yeasts of this genus have not been associated with surface films present on brined material (Mrak and Bonar; Henrici).

Distribution of Isolates According to Source

For this discussion, cultures from both media used for isolations will be grouped together since no outstanding floral differences arose through the use of the glucose agar with salt. The summarized results (table 3) show that two yeasts, *T. caroliniana* sp. nov. and *B. versatilis* sp. nov., were consistently found in all 20 fermentations and represented the bulk (88 percent) of all cultures identified. It appears that the individual brining treatment may have exerted an influence on the frequency with which certain of the minor species were obtained. For example, all of the isolates of *Torulopsis holmii*, *Torulaspora rosei*, 45 of the 46 *Hansenula subpelliculosa* cultures, and 50 of the 59 *Zygosaccharomyces* isolates came from plant A. Also, none of the 27 cultures of the new species, *B. sphaericus* was obtained at plant A. As mentioned before, generally this plant employed a much slower rate of increase in brine strength (from 10 to 16 percent) than plant B, and considerably lower total yeast populations were obtained (Cf. figure 1). In connection with the 45 isolates of *H. subpelliculosa* obtained at plant A, 28, or 62 percent, came from one fermentation (vat 167). This was the only case of what amounted to an active fermentation by this yeast. The 50 *Zygosaccharomyces* (species A) cultures came from 8 fermentations at plant A, whereas the 9 cultures of species B all came from one fermentation (sheltered vat 15–10) at plant B.

TABLE 3. DISTRIBUTION OF BRINE YEASTS ACCORDING TO SOURCE OF ISOLATION (1947 SEASON).

Vat No.	I *Torulopsis*				II *Brettanomyces*				III *Zygosaccharomyces*				IV *Hansenula*		V *Torulaspora*		Unclassified		Total Isolations per Vat	
	T. caroliniana		*T. holmii*		*B. versatilis*		*B. sphaericus*		*Z.* sp. A		*Z.* sp. B		*H. subpelliculosa*		*T. rosei*					
Plant A	GA[1]	GS[2]	GA	GS	GA	GS	GA	GS	GA	GS	GA	GS	GA	GS	GA	GS	GA	GS	GA	GS
F–161	18	12	0	0	15	13	0	0	3	1	0	0	4	1	0	0	0	0	40	27
F–163	19	13	1	1	10	9	0	0	4	1	0	0	2	2	0	0	1	0	37	26
F–164	20	14	1	0	14	12	0	0	8	2	0	0	2	2	0	0	0	0	45	30
F–167	12	9	0	0	11	11	0	0	0	0	0	0	17	11	0	0	0	0	40	31
F–221	18	16	0	0	9	12	0	0	5	0	0	0	1	0	1	0	1	0	35	28
F–236	17	11	1	0	13	14	0	0	6	2	0	0	1	1	1	0	0	0	39	28
F–287	7	9	0	0	12	9	0	0	2	3	0	0	0	0	1	1	2	0	25[3]	22
F–288	9	10	0	0	12	10	0	0	0	0	0	0	1	0	0	0	0	0	22	20
F–291	22	8	0	0	7	9	0	0	8	4	0	0	0	0	0	0	0	0	37	21
F–10	6	5	0	0	13	10	0	0	1	0	0	0	0	0	0	0	1	0	21	15
Sub-total	148	107	3	1	116	109	0	0	37	13	0	0	28	17	3	1	5	0	341	248
Plant total	255(43.3%)		4(0.7%)		225(38.2%)		0		50(8.6%)		0		45(7.7%)		4(0.7%)		5(0.8%)		589	

Plant B	GA	GS	GA	GS	GA	GS	GA	GS	GA	GS	GA	GS	GA	GS	GA	GS	GA	GS	GA	GS
21–20	23	11	0	0	18	19	0	1	0	0	0	0	0	0	0	0	0	1	41	32
21–21	20	13	0	0	15	12	0	0	0	0	0	0	0	0	0	0	1	0	36	25
22–21	22	10	0	0	19	14	0	0	0	0	0	0	0	0	0	0	0	0	41	24
1–7	17	14	0	0	23	16	0	0	0	0	0	0	0	0	0	0	0	0	40	30
23–3	18	11	0	0	14	17	0	0	0	0	0	0	1	0	0	0	2	0	35	28
23–4	25	13	0	0	17	11	0	2	0	0	0	0	0	0	0	0	0	0	42	26
14-10 [4]	27	13	0	0	7	4	5	6	0	0	0	0	0	0	0	0	3	0	42	23
15–10 [4]	21	11	0	0	2	2	1	7	0	0	7	2	0	0	0	0	0	4	31	26
B1–1	24	9	0	0	16	9	0	2	0	0	0	0	0	0	0	0	2	0	42	20
B2–13	14	8	0	0	15	11	0	3	0	0	0	0	0	0	0	0	2	0	31	22
Sub-total	211	113	0	0	146	115	6	21	0	0	7	2	1	0	0	0	10	5	381	256
Plant total	324(50.9%)		0		261(41.0%)		27(4.2%)		0		9(1.4%)		1(0.2%)		0		15(2.3%)		637	
GRAND TOTAL 20 Vats	579(47.3%)		4(0.3%)		486(39.7%)		27(2.2%)		50(4.1%)		9(0.7%)		46(3.8%)		4(0.3%)		20(1.6%)		1226	

[1] Isolates from glucose agar.
[2] Isolates from glucose agar with salt.
[3] Total includes 1 *Kloeckera magna* obtained at the first sampling, 24 hrs. after filling and brining.
[4] Sheltered vats; all others in open.

Predominance of Individual Species

The results for the 2-year study with respect to the individual number of isolates assigned to individual species, and their percentage of the total isolations made (column 1 of table 2), are given for the six generic groups

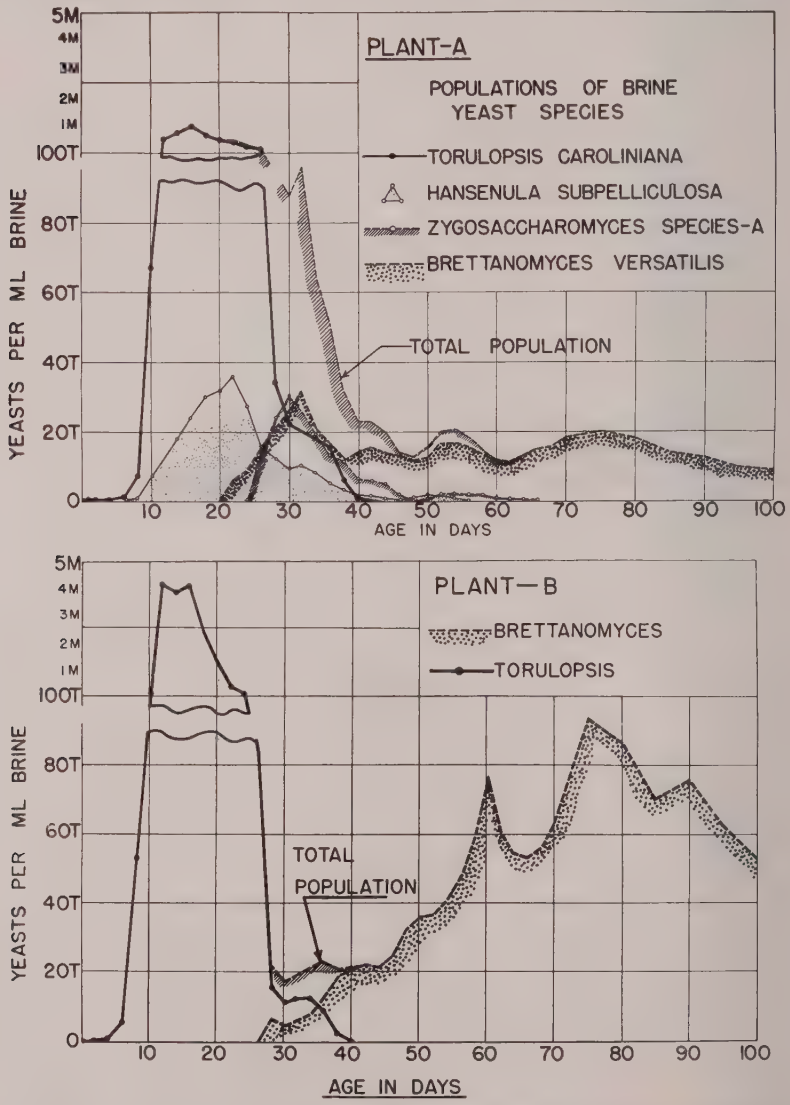

Figure 2. Yeast populations at two commercial plants according to sequence of species. Upper part, plant A; lower part, plant B.

encountered, in the decreasing order of frequency with which they were found.

The *Torulopsis* and *Brettanomyces* genera represented 1,309 cultures out of 1,444, slightly over 90 percent of all yeasts isolated, were obviously by far the types most frequently obtained. The remaining four genera (*Hansenula, Zygosaccharomyces, Torulaspora*, and *Kloeckera*), constituted but 115 cultures, about 8 percent of the total isolates. A breakdown of the two principal genera found shows that two individual species within *Torulopsis* and *Brettanomyces*, i.e., the tiny-celled yeast *T. caroliniana* sp. nov. and the fermentative yeast *B. versatillis* sp. nov., predominated, accounting for 1,278 cultures, 88.4 percent of the total cultures. The former species represented almost 50 percent of all cultures, and the latter nearly 40 percent.

Before it can be stated whether a definite sequence of species existed during the general fermentation, a few remarks concerning their respective periods of activity are needed. At both plants the tiny-celled yeast, *T. caroliniana* sp. nov., after starting growth within about 7 days, represented the bulk of the total populations, until about the 30th day, when their numbers declined. At plant B, these yeasts reached much higher numbers than at plant A. Between the 25th to 40th day, the fermentative yeast, *B. versatilis* sp. nov., appeared and thereafter was consistently found throughout the remainder of the 100-day period of observation. In the case of plant B this yeast appeared later but reached definitely higher numbers (five-to ten-fold) than for plant A. The less frequently obtained species from plant A were found as follows: The cultures of *Torulopsis holmii* and of *Torulaspora rosei* appeared at the end of the fermentation by *Torulopsis caroliniana*. The *Zygosaccharomyces* (Type A) appeared between the 32d to the 55th day. The *Hansenula subpelliculosa* cultures generally were found near the end of the *T. caroliniana* fermentation; in the case of vat 167 they were consistently found between the 18th and 49th days. The less frequently obtained yeasts at plant B were the Type B *Zygosaccharomyces* found between the 43rd to 70th day (in one vat only); and the poorly fermentative *Brettanomyces* species found between the 23rd to 70th day.

A general picture as to yeast sequence in the fermentations at plants A and B, based on the glucose agar isolates from the 1947 season, is shown in figure 2. In the preparation of these diagrams, only data for four principal yeasts that showed definite individual population trends were used. Data for the two sheltered vats from plant B (vats 14–10 and 15–10) are omitted because the brine strengths in these two cases, after reaching 15 percent, were not increased as were the 8 outside vats.

Description of New Species

Torulopsis caroliniana sp. nov.

Cellulae parvae vel perpusillae, breve ovales vel ovoideae, plerumque aggregatae, in agaro glucoso in 24–48 horis 1.5–2 x 3–4 μ; in mediis liquidis multo saccharosis leniter

majores; fermentationem glucosii, sucrosii, raffinosii (⅓) in diebus 2–3 inducens, jure glucoso cito claro, annulo et pellicula absentibus; fermentatio maltosii, galactosii, lactosii, et melibiosii non visa, set assimilatio galactosii producta; auctus in alcoholi ethylico carens; reductio valida nitrati ad nitritum in diebus 3–4; pseudomycelium non visum in agaro solanaceo nec maltoso in 3 hebdomadibus; in jure solanaceo solo coloniae cellularum elongatarum praesentes; ascosporae non visae in mediis 8 sporulantibus menses plures observatis; cellulae caducae (3–6 hebdomades) in mediis vulgaribus; productio definita acidi in mediis cretaceis; culturae in mediis glucosis albae, madidae, coruscae, auctu moderato; colonia gigantea in agaro glucoso parva, circa 1 cm mense una, typice margine lobato et annulis concentricis praedita, centro in aetate ferruginosa; fermentationem rapidam solutionum 40–60% saccharium inducens; toleratio salis $>$ 15 sed $<$ 20% in culturis, in fermentationibus salsimentorum naturalibus supra 15%.

In fermentationibus salsimentorum cucumeris (10–15% salis) in diebus 7–30.

Cells, small to tiny, short-oval to egg-shaped, usually in clusters. On glucose agar slants and broth at 24 to 48 hours, cells average 1.5–2 x 3–4 μ; cells slightly larger in liquid media with higher sugar concentrations. Rapid fermentation of glucose, sucrose, raffinose (⅓) within 2 to 3 days. Glucose broth clears rapidly; no ring, no film. No fermentation observed for maltose, galactose, lactose, and melibiose; but, moderate assimilation of galactose is obtained. No growth in ethyl alcohol. Strong reduction of nitrate (KNO_3) to nitrite after 3 to 4 days (chemical test). Pseudomycelium not found on cornmeal or malt extract agar in 3 weeks; none found in potato broth, only cell colonies with more elongated cells. Ascospores not found on 8 sporulating media observed over several months. Cells short-lived on slants of ordinary media (3 to 6 weeks). Definite acid production on chalk containing media. Glucose slant cultures white, moist, glistening with scant to moderate amount of growth. Giant colony on glucose agar small, approximately 1 cm. at 1 month, characteristically lobed edge with concentric rings. Slight rust color starting at the center with age. Rapid fermentation of high sugar solutions (40 and 60 percent by weight). Tolerance to salt is $>$ 15 but $<$ 20 percent by weight in cultural tests; tolerance in natural brine fermentations slightly above 15 percent. Source: During the active fermentation of cucumber brines (10 to 15 percent salt), starting on about the 7th day, and continuing until about the 30th day.

Brettanomyces versatilis sp. nov.

Cellulae plerumque ovales, interdum rotundae; in agaro et jure glucosis in 48–72 horis 3–4 x 4–5 μ; cellulae ogivae in culturis vetustis; fermentationem glucosii, sucrosii, maltosii, galactosii, lactosii, raffinosii et melibiosii inducens; fermentatio mediorum saccharinorum tarda et menses plures protracta; auctus in alcoholi ethylico bonus, annulo praesenti sed pellicula carenti, etiam in jure glucoso; reductio nitrati in nitritum moderata; pseudomycelium non visum in agaro farinae zeae in 3 hebdomadibus nec in jure solanaceo in 2 mensibus; ascosporae non visae in mediis 8 sporulantibus in mensibus pluribus; cellulae in mediis vulgaribus caducis (4–6 hebdomades) cultures circa 9 menses in jure 4% lactoso in temperatura vulgari persistantes; productio valida acidi in medio cretaceo in culturis aerobicis; culturae juveniles in agaro glucoso albae, coruscae, leves, demum in culturis vetustis e centro roseae usque lavendulae; colonia gigantea in agaro glucoso alba, levis, annulis concentricis inconspicuis praedita, demum

infra e centro rosea usque lavendula; fermentationem solutionum sucrosium (40–60%) inducens; toleratio salis extrema (20–24%) in fermentationibus artifactis et naturalibus.

In fermentationibus salsimentorum cucumeris in diebus 30 usque 100 longe et tarde continuanti.

Cells predominately oval but some round. On glucose agar slants and broth at 48 to 72 hours, cells average 3–4 x 4–5 μ. Characteristic cell colonies from broth; typical ogive cells in old cultures. Fermentation of glucose, sucrose, maltose, galactose, lactose, raffinose, and melibiose. Characteristic slow, prolonged fermentation of sugar media over a period of months. Good growth in ethyl alcohol; ring but no film. Ring but no film in glucose broth. Moderate reduction of nitrate (KNO_3) to nitrite (chemical test). Pseudomycelium not found on cornmeal agar in three weeks, or in potato broth after 2 months. Ascospores not found on 8 sporulating media observed over several months. Cells short-lived on slants of ordinary media (4 to 6 weeks). Cultures can be maintained for approximately 9 months in 4 percent lactose broth at room temperature. Strong acid production on chalk media in aerobic culture. Young, glucose slant cultures white, glistening and smooth. Latent development of a pink to lavender color in old cultures starting from center area. Giant colony on glucose agar dull white, smooth, with slight concentric rings. Latent development from center (bottom) of pink to lavender color. Fermentation of high sucrose solutions (40 and 60 percent by weight). Extremely salt-tolerant in both laboratory tests and natural fermentations (20 to 24 percent by weight). Source: During the latter part of the fermentation of cucumber brines, starting at about 30 days and continuing in a slow, prolonged manner until at least the 100th day.

Brettanomyces sphaericus sp. nov.

Cellulae plerumque rotundae, in agaro glucoso in 48–72 horis 3–5 μ in diam., vel interdum paulo majores, in jure aggregatae; cellulae ogivae in culturis vetustis; fermentationem tardam glucosii maltosiique inducens, non sucrosii, galactosii, lactosii, raffinosii nec melibiosii; sucrosium et galactosium utuntur; auctus moderatus in alcoholi ethylico, annulo praesenti sed pellicula carenti, etiam in jure glucoso; reductio nitrati ad nitritum latens; pseudomycelium non visum in agaro farinae zeae in 3 hebdomadibus; ascosporae non visae in mediis variis sporulantibus menses plures observatis; cellulae caducae in mediis vulgaribus; productio acidi moderata in mediis cretaceis in culturis aerobicis; culturae juveniles in medio glucoso albae, leves, coruscae, integrae, auctu abundanti; fermentatio solutionum 40% glucosium auctu flocculento; fermentatio tarda solutionum 60% sucrosium, ad 40% debilis, ad 20, 10 et 5% absens; toleratio salis magna in mediis artifactis et fermentationibus naturalibus 18–20%.

In statibus ultimis fermentationis salsimentorum cucumeris in concentrationibus magnis (15–20%) salis.

Cells predominately round; those from glucose agar slants and broth at 48 to 72 hours, 3–5 μ in diameter; some slightly larger. Clusters of many cells in broth; a tendency for ogive cells in old cultures. Slow fermentation of glucose and maltose. Sucrose, galactose, lactose, raffinose, and melibiose not fermented, but sucrose and galactose utilized. Moderate growth in

ethyl alcohol; ring but no film. Ring but no film in glucose broth. Latent reduction of nitrate (KNO_3) to nitrite. Pseudomycelium not found in cornmeal agar in three weeks. Ascospores not found on several sporulating media observed over several months. Cells somewhat short-lived on slants of ordinary media. Moderate acid production on chalk media in aerobic culture. Young, glucose slant cultures white, smooth, glistening, entire, with abundant growth. Fermentation of 40 percent glucose solutions with flocculent growth. Slow fermentation of 60 percent sucrose solutions; feeble fermentation of 40 percent; no fermentation at lower concentrations (20, 10, and 5 percent). Very salt-tolerant in artificial media and in natural brine fermentations (18 to 20 percent by weight). Source: During latter part of the fermentation of certain cucumber brines at high salt concentration (15 to 20 percent).

TABLE 4. EXAMINATION OF SALT-STOCK CUCUMBERS FROM SEVEN FERMENTATIONS (PLANT A) FOR BLOATERS OR HOLLOW CUCUMBERS.

Vat Number (and Date Opened–1948)	Amount of Salt Stock Examined [1]	Bloaters Found	
	bushels	*bushels*	*percent*
F–161 (4–20)	265	144	54
F–163 (4–24)	282	66	23
F–164 (4–27)	274	106	39
F–167 (5–1)	391	176	45
F–221 (5–28)	302	114	38
F–236 (5–27)	305	159	52
F–288 (5–27)	177	81	46

[1] Vats contained large sized cucumbers (1½ inches in diameter or larger).

Bloater Formation During Fermentation

After the completion of the curing period, the salt-stock from the 10 vats at one of the plants was graded out for percentage of bloaters (hollow cucumbers). This was done according to regular plant procedure. The results for seven vats, those that contained large sized cucumbers (1½ inches in diameter and larger), are shown in table 4. The proportion of bloaters found ranged from 23 to 54 percent of the total amount of stock in individual vats. Bloater formation was attributed to the gaseous yeast fermentation, and *Torulopsis caroliniana* was considered to be the principal

species involved. The results on the number of bloaters formed are comparable to those reported by Jones, Etchells, Veerhoff, and Veldhuis (1941) for large sized cucumbers cured in barrels and 85-bushel vats at 10.5 percent brine strength.

Three lots, vats F-287, F-291 and F-10, not shown in table 2, contained small sized stock (less than 1½ inches in diameter). These graded out less than 10 percent bloaters. The relationship of less bloaters being formed during gaseous fermentation when smaller sized cucumbers are brined is the same as that shown earlier by the above authors.

DISCUSSION

The tiny yeast, *T. caroliniana* sp. nov., and the new *Brettanomyces* species, *B. versatilis*, were in consistently higher numbers in the brines of plant B as compared to plant A. This is attributed to the influence of the more rapid increase in brine strength employed by plant B which markedly reduced the growth of the less salt-tolerant lactic acid bacteria, thereby leaving more fermentable material from the cucumbers for the yeasts. This relationship was readily demonstrated by definitely lower brine acidities for plant B, as compared to plant A, and lower numbers of lactic acid bacteria as demonstrated by microscopic examination and plate counts for these organisms. Previous studies (Jones and Etchells, 1943) have shown that only a very small amount of fermentable sugar remains in the brines by the end of the first 30 days. Hence, the *Brettanomyces* fermentation evidently was supported by another carbon source; probably the ethyl alcohol produced earlier by the *Torulopsis* species, *T. caroliniana*, or the organic acids contributed chiefly by the lactobacilli.

The two species, *T. caroliniana* and *B. versatilis*, dominated the yeast flora at plant B; they were also the types most frequently isolated at plant A. There was evidence, however, of fermentation trends of two additional yeasts, *Hansenula subpelliculosa* and *Zygosaccharomyces* (species A) at the latter plant. Although neither of these yeasts was found in all ten fermentations, they were, however, found with sufficient frequency to indicate at least a minor role in the average fermentation. The well-developed fermentation by *H. subpelliculosa* in vat 167 would be sufficient evidence to warrant inclusion of this yeast in any general consideration of the yeast flora. Since both of these yeasts made their appearance near the end of active development of the tiny-celled *Torulopsis*, it seems plausible that lack of a readily fermentable carbon source was the major factor which limited their continued development. Neither type grows particularly well in ethyl alcohol as compared to the yeast that succeeded them in the brines, namely, *B. versatilis*. The latter species at plant A did not reach populations much above 10,000 to 15,000 per ml. from about the 35th day on, which is further evidence of lack of nutrients in these brines. It is doubtful if the brine acidity had much of an inhibitory influence on the species of *Hansenula*, *Zygosaccharomyces*, and *Brettanomyces* in plant A brines. Such an effect would have first been noticeable on the *Torulopsis* fermenta-

tion, since these yeasts are much more sensitive to the brine acid than the other genera mentioned.

In an investigation of this kind, the principal limiting factor on the extent of species separation is the number of isolates than can be picked and subsequently identified. Even with an unlimited number of isolates from the high dilution plates there is always the question of what minor species might be present at lower population levels. In this connection, it is conceivable that the *Brettanomyces* started growth at about the same time as the tiny-celled *Torulopsis* (about 7 days); but due to lower population levels did not become "predominating" until the tiny yeasts were reduced to a level so that the former group appeared on the plates. The same is probably partly true for the *Hansenula* and *Zygosaccharomyces*. Better separation could no doubt be effected by development of differential media for detection of specific yeast groups, based on their particular biochemical properties.

SUMMARY

A study of the yeasts predominating during the fermentation of cucumbers under commercial conditions is presented. During the 1946 and 1947 seasons, 1,444 isolates were obtained by frequent sampling of 42 fermenting vats at two commercial pickle plants in eastern North Carolina. During the period of observation, the brine strength of the fermentations was within the range of 10 to 18 percent by weight.

The 1,444 isolates were reduced to the following six genera in the order of frequency of isolation; *Torulopsis* (721); *Brettanomyces* (588); *Zygosaccharomyces* (59); *Hansenula* (49); *Torulaspora* (6); *Kloeckera* (1); plus 20 isolates not fully classified. The first two genera named represented a total of 1,309 cultures or slightly over 90 percent of all yeasts isolated. Furthermore, two new species within these genera, the tiny yeast *Torulopsis caroliniana* sp. nov., and the very fermentative yeast, *Brettanomyces versatilis* sp. nov., predominated, accounting for 1,278, or slightly over 88 percent of the total cultures. The first species dominated the early part of the fermentation and was then followed by the second in a slow fermentation which continued up to the end of the observation period (about 100 days). This was the most clear-cut yeast sequence obtained for all 20 fermentations at both plants. In addition, 4 cultures of *Torulopsis holmii* (Jörgensen) Lodder were found, as well as 27 cultures that have been placed in the *Brettanomyces* genus as *B. sphaericus* sp. nov.

The remaining four genera (*Zygosaccharomyces*, *Hansenula*, *Torulaspora*, and *Kloeckera*) obtained less frequently consisted of 115 cultures, or about 8 percent of the total isolates. These cultures were placed as follows: The 59 *Zygosaccharomyces* (50, type A; 9, type B) were not identified as to species due to the confused state of the genus; the *Hansenula* were considered to be *H. subpelliculosa* Bedford; the *Torulaspora* isolates were identical to *T. rosei* Guillermond; the single isolate of *Kloeckera* was similar to *K. magna* (De 'Rossi) Janke. All the above 115 cultures, with the exception of 9 maltose fermenting *Zygosaccharomyces* cultures and 1

culture of *H. subpelliculosa* were obtained from one plant, as were the 4 cultures of *T. holmii*. This was attributed to the difference in brining treatment.

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ADDENDUM

The 9 yeast isolates referred to in this report as species B of the genus *Zygosaccharomyces* (Cf. table 2, column 1, Group III, and table 3, column 7) are considered to be the same as *Z. halomembranis* sp. nov. recently obtained from films on commercial cucumber brines. (Cf. Etchells, J. L., & T. A. Bell. 1950. Film yeasts on commercial cucumber brines. Food Tech., 4:77–83.)

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A REVIEW OF CERAMIUM ALONG THE PACIFIC COAST OF NORTH AMERICA WITH SPECIAL REFERENCE TO ITS MEXICAN REPRESENTATIVES [1]

E. YALE DAWSON

As a result of explorations for marine algae along the Pacific Mexican coast during the last 25 years, the number of species of *Ceramium* recorded in our Pacific North American marine flora has been increased nearly five-fold. Notwithstanding, no key to the species, nor survey of the genus as it is represented in our flora has been prepared, while the task of identifying our plants has become increasingly more difficult and uncertain.

Within the past four years the writer's field work in Mexico has brought to hand some three hundred separate collections of *Ceramium*, study of which has shown that all but two of the known Pacific Coast species occur in Mexico. Several apparently undescribed plants have been detected, and these, together with some troublesome uncertainties among our older species, have called for a practical treatment of the genus at this time. Of each of these new Mexican collections, material kept in liquid preservative has made possible the preparation in a uniform manner of a series of permanent study-slides in which the specimens exhibit minimum distortion.

Dr. George J. Hollenberg of the University of Redlands, Redlands, California, has kindly made available for this study his fine collection of *Ceramium* from southern California. These specimens, particularly his numerous slide preparations, have been most useful in verifying a number of determinations and in indicating northernmost localities in the distribution of many species.

Examples of all of the collections cited, except those of Hollenberg, are on file in the Herbarium of the Allan Hancock Foundation. All collection numbers are the writer's unless otherwise indicated. The dates of the author's collections are as follows: 16–1094, January–February 1946; 1095–1655, April 1946; 1646–1989, May 1946; 2756–3145, October 1946; 3146–3581, November 1946; 3582–3764, December 1946; 3765–3940, January–February 1947; 5143–5312, September 1948; 6462–7278, March 1949.

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A KEY TO THE SPECIES OF CERAMIUM OF THE PACIFIC COAST OF NORTH AMERICA [1]

1. Thallus completely corticated throughout 2
1. Thallus with nodal cortication for the most part continuous, but at least in some part with ecorticate internodal spaces, or the cortex thin and loose over internodes 8
1. Thallus with cortication only at the nodes, or with uninterrupted cortication only in older, lower parts or on reproductive branches 9
   2. Thallus bearing deciduous or persistent spines on apices or on short, lateral branches 3
   2. Spines absent 4
3. With sharp, unicellular spines at apices or terminating short, lateral branchlets ..... **1. Ceramium horridum**
3. With two or more multicellular spines terminating mature apices of main or lateral branches ..... **7. Ceramium pacificum** (in part)
   4. Cortical cells, at least for the greater part, in distinct longitudinal rows; apices divergent ..... **2. Ceramium Eatonianum**
   4. Cortical cells not in distinct, longitudinal rows; apices divergent or forcipate 5
5. Plants with penetrating, bulb-tipped, pigmented rhizoids ..... **3. Ceramium codicola**
5. Plants without bulbous rhizoids 6
   6. Plants creeping, extremely robust, the cortex 200 μ thick or more ..... **5. Ceramium obesum**
   6. Plants erect, not particularly robust; cortex much thinner 7
7. Apices divergent; with many short, proliferous branches, densely congested above ..... **6. Ceramium viscainoense**
7. Apices more or less incurved; with many proliferous branchlets, but these not congested in upper parts .. **7. Ceramium pacificum** (in part)
   8. Cortical bands only slightly separated above, covering the expanding internodes below by basipetal growth, but the secondary cortication thin, loose and often incomplete; with many proliferous branchlets ..... **8. Ceramium washingtoniense**
   8. Nodal cortication discontinuous, particularly so in lower parts, usually continuous above or irregularly discontinuous; usually without conspicuous proliferous branchlets ..... **4. Ceramium sinicola** (in part)
   8A. Cortication continuous above, but not in lower and middle portions .. .. **4. Ceramium sinicola** var. **typicum**
   8A. Cortication generally continuous above, but conspicuously interrupted at the dichotomies ..... **4. Ceramium sinicola** var. **interruptum**

[1] It should be emphasized that identifications according to this key will be most successful when the material being examined is fresh or in liquid-preserved state, since drying distorts the appearance and arrangement of the cortical cells upon which a number of distinctions are based.

8A. Cortication continuous except in extreme basal parts ..... **4. Ceramium sinicola** var. **Johnstonii**

9. Plants bearing conspicuous multicellular spines 10

9. Plants without conspicuous spines 11

10. Spines mainly abaxial, more or less deciduous ..... **9. Ceramium paniculatum**

10. Spines whorled at the nodes, persistent ..... **10. Ceramium hamatispinum**

11. Cortical band showing conspicuous basipetal and (or) acropetal secondary growth 12

11. Cortical band without conspicuous basipetal or acropetal secondary growth 13

12. Tetrasporangia immersed within the cortical band ..... **11. Ceramium Evermannii**

12. Tetrasporangia projecting from the cortical band ..... **12. Ceramium californicum**

13. Cortical cells arranged in distinct horizontal and vertical rows in lower two thirds of the nodes ..... **14. Ceramium recticorticum**

13. Cortical cells not arranged in vertical rows 14

14. Outer cortical cells of nodal band separated into two groups by a horizontal clear space usually at about the lower third of the node; tetrasporangia involucrate 15

14. Outer cortical cells of nodal band not clearly divided into two groups; tetrasporangia immersed, involucrate or naked 17

15. Nodes of most filaments each bearing, at first abaxially, a short, thick, apically rounded, unicellular hair, or these later sometimes whorled ..... **13. Ceramium fimbriatum**

15. Nodes without such a specialized hair 16

16. Cells of lower portion of divided cortical band distinctly and persistently horizontally elongated .... **15. Ceramium Masonii**

16. Cells of lower portion of divided cortical band, except in young stages, angular, small and not distinctly horizontally elongated ..... **16. Ceramium Taylorii**

17. Tetrasporangia immersed in the cortex, not projecting 18

17. Tetrasporangia projecting, naked 23

17. Tetrasporangia projecting and involucrate, at least by bracteate filaments (sometimes secondary tetrasporangia obscurely involucrate in *C. personatum*) 20

18. With conspicuous opposite branching; procumbent ..... **17. Ceramium procumbens**

18. Without conspicuous opposite branching; erect or entangled 19

19. Filaments 140–200 μ diam. or more **4. Ceramium sinicola** (in part)

19. Filaments 80–100 μ diam. ..... **18. Ceramium equisetoides**

20. Filaments less than 50 μ diam. 21

20. Filaments 70–200 μ diam. 22

21. Tetrasporangia solitary at the nodes, the involucres unilateral ..... **19. Ceramium serpens**

21. Tetrasporangia whorled at the nodes, the involucres symmetrical ..... **20. Ceramium Camoui**

22. Cortical band about half as long as broad; tetrasporangia initially secund, mainly abaxial, later whorled, more or less involucrate by bracteate filaments; with descending rhizoidal appendages within some of the axial cells ..... **24. Ceramium personatum**

22. Cortical band about half as long as broad; tetrasporangia initially secund, mainly adaxial, later whorled, slightly involucrate; without appendages within the axial cells ..... **21. Ceramium Gardneri**

22. Cortical band one third to half as long as broad; tetrasporangia secund, abaxial, conspicuously involucrate throughout; without appendages within the axial cells ..... **22. Ceramium mazatlanense**

23. Plants smaller, the lower nodes rarely exceeding 130 μ in diameter 24

23. Plants larger, the lower nodes 150–450 μ in diameter (sometimes not over 130 μ in slender forms of *C. caudatum*) 26

24. Internodes ordinarily less than 3 times as long as cortical band; adult nodes of more than 2 tiers of cells 25

24. Internodes, except near tips, 4–10 times as long as cortical band; nodes of only 2 tiers of cells ... **23. Ceramium affine**

24A. Filaments less than 35 μ diam. ..... **23. Ceramium affine** var. **originale**

24A. Filaments more than 40 μ diam. ..... **23. Ceramium affine** var. **peninsularis**

25. Cortical band consisting of larger, rounded, downwardly directed cells in lower part of band, and smaller, angular cells in upper part; lower internodes 1½–2 times as long as broad; distantly branched ..... **25. Ceramium avalonae**

25. Cortical bands with irregularly arranged, small, angular cells on the surface throughout; lower internodes less than as long as broad; rather densely branched above ..... **26. Ceramium zacae** (in part)

26. Upper branches reduced in diameter, commonly 100 μ or less; tetrasporangia appearing large compared to bearing cortical band, ¼ the diameter of the band or larger 27

26. Upper branches not much reduced in diameter, commonly over 150 μ (to 300 μ); tetrasporangia mostly appearing small compared to bearing cortical band 28

27. Older internodes less than as long as broad ..... **26. Ceramium zacae** (in part)

27. Older internodes 1.5–2.5 times as long as broad ..... **27. Ceramium caudatum**

28. Apices prominently circinate-forcipate; tetrasporangia mainly projecting from adaxial surface of the node or sometimes scattered around the entire node ..... **28. Ceramium clarionensis**

28. Apices not circinate; tetrasporangia whorled, projecting from upper half, particularly the upper margin, of the cortical band ..... **29. Ceramium ornatum**

SYSTEMATIC LIST

1. CERAMIUM HORRIDUM Setchell & Gardner

Setchell & Gardner, 1924, p. 777, pl. 26, figs. 49, 50, pl. 79; Dawson, 1944, p. 318.

Previously well-known in the Gulf of California from Guaymas, Sonora and northward, this distinctive plant has recently been collected in the

southern Gulf of California at Isla Carmen (Dawson 6965), in San Lorenzo Channel (Dawson 6926) and at Mangles Anchorage north of Isla Carmen (AHF Sta. 526–36). Its spination makes it one of the most readily recognized of the completely corticated species of our coast.

2. CERAMIUM EATONIANUM (Farlow) De Toni

De Toni, 1903, p. 1493; Smith, 1944, p. 327, pl. 84, figs. 3–4; Dawson, 1945a, p. 62, 67; 1949a, p. 223; Taylor, 1945, p. 271; Doty, 1947, p. 187. *Centroceras Eatonianum* Farlow, 1875, p. 373. *Ceramium zebrinum* J. Agardh, 1894, p. 37. *Centroceras oregonense* J. Agardh, 1876, p. 107.

Although long well-known in California and in Oregon, this plant has previously been reported in Mexico only from Punta Descanso, Cabo Colnett and Isla Cedros. Recent collections show that it is common along virtually the entire west coast of Baja California. Specimens are now at hand from Punta Baja (Dawson 1142), Miller's Landing (1379), Punta Santa Rosalía (1426, 1513, 2918), Bahía Ositos (1591) and from Bahía Santa María, Isla Magdalena (7267).

3. CERAMIUM CODICOLA J. Agardh

Plate 1, fig. 6

J. Agardh, 1894, p. 23; Setchell, 1905, p. 60; Smith, 1944, p. 326, pl. 84, fig. 1; Doty 1947, p. 187; Dawson, 1944, p. 318 (in part). *Ceramium codiophila* Setchell & Gardner, 1937, p. 89, pl. 8, figs. 23, 24; Dawson, 1945, p. 25.

Although this species has been known in the California flora for over half a century, it has apparently become increasingly misunderstood as the knowledge of our flora has been extended southward. In 1905, Setchell correctly pointed out one of the major distinguishing features of *Ceramium codicola*: unbranched, chromatophore-containing rhizoids with large, globular ends. Smith, 1944, reiterated this character in describing the plant from Monterey, but it has not heretofore been noticed that the plant distributed in the Phycotheca Boreali-Americana as no. 248 and verified by Kylin, 1941, as identical with the Agardhian type, is not identical with the plant most commonly found epiphytic on *Codium fragile* at La Jolla, and elsewhere in southern California. We have, in fact, two species of *Ceramium* of similar external appearance epiphytic on *Codium*, the one, *C. codicola*, of northern occurrence, north to Alaska, and the other, *C. sinicola*, of southern occurrence south to San José del Cabo and in the Gulf of California (see discussion below). In southern California the ranges of the two species overlap, *C. codicola* being occasional in drift at La Jolla and common on *Codium* in the Channel Islands. *C. sinicola* is common on intertidal *Codium* at La Jolla and may occur on a number of other hosts.

The specimens from Isla Guadalupe, Baja California described by Setchell and Gardner as *Ceramium codiophila* seem clearly to correspond with the original concept of *C. codicola*. Similarly far southern locals for this species are represented by Dawson 2838 from Punta Santa Rosalía, Bahía Viscaino and by Howell 20b, Bahía San Bartolome, Baja California.

4. CERAMIUM SINICOLA Setchell & Gardner

Plate 1, figs. 4–5

Setchell & Gardner, 1924, p. 773, pl. 25, figs. 40, 41, pl. 75; Dawson, 1944, p. 315; Hollenberg, 1948, p. 158 (in major part). *Ceramium bicorne* Setchell & Gardner, 1924, p. 773, pl. 28, fig. 64, pl. 74. *Ceramium Johnstonii* Setchell & Gardner, 1924, p. 774, pl. 76, 77. *Ceramium interruptum* Setchell & Gardner, 1924, p. 775, pl. 26, fig. 47. *Ceramium codicola* J. Agardh, as interpreted by Dawson, 1944, p. 318 (in part); 1945, p. 67; 1949, p. 26.

Hollenberg's recent report of this species in southern California has called for a review of the species as a whole, and particularly for a clarification of the type locality. The type specimen, found entangled with a *Laurencia* species, was cited by Setchell and Gardner from the Gulf of California following their assumption that "Ensenada Bay" indicated on the original label was in that region. Reëxamination of the original *Laurencia* specimen, Ivan Johnston 67, kindly loaned by the Herbarium of the University of California, shows that it is probably *L. subopposita*, not a species of the Gulf of California, and is associated with another plant unknown there, *Pterosiphonia Baileyi*. A comparison of the date, April 7, 1921, with the general account (Slevin, 1923) of the Expedition of the California Academy of Sciences to the Gulf of California in 1921, reveals that on that date Johnston was aboard the steamer Mazatlán which had departed from Los Angeles, southward bound, on April 5. This would have placed Johnston at Bahía de Todos Santos (often known as Ensenada Bay) Baja California on the date indicated on the label, and explains the identity of the *Laurencia* and *Pterosiphonia* which are not in keeping with the flora of the Gulf. *Ceramium sinicola* becomes, thus, a species positively known from Pacific Baja California by reason of the type. This enables us more readily to accept a wide distribution for this species including southern California, Pacific Baja California and the Gulf of California, an interpretation strongly supported by the large Mexican *Ceramium* collections now at hand.

Although both *Ceramium sinicola* and *C. codicola* occur on *Codium* along southern California and northern Baja California where their ranges overlap, the characters of their rhizoids make them readily distinguishable. The former produces slender, branched, non-bulbous rhizoids (fig. 5) which may be of various lengths and depths of penetration depending upon the texture of the host to which they attach. In *C. codicola*, which seems to occur only on *Codium*, the unbranched rhizoids are pigmented and bulbous at the tips (fig. 6).

One to several multicellular spines commonly occur on mature apices of *C. sinicola* (fig. 4). Such spines appear to be absent in *C. codicola*.

Ceramium sinicola is an extremely variable plant, in habitat, size and in cortication, and in some of its varied forms may be confused with other species. It is best identified by means of a series of several specimens, both juvenile and mature, among which the characters particularly of the cortication may be interpreted. In the great majority of cases the uppermost,

mature parts of the plants show complete cortication, or cortication only here and there interrupted, most commonly just above the dichotomies. The more slender, basal branches, however, ordinarily show prominent internodal spaces between the truncate cortical bands. In some of the more slender forms, and those growing in less exposed situations, there may be widely discontinuous cortication with internodes in the lowermost, prostrate portions up to 3 times the length of the cortical bands. Depending upon the continuous or discontinuous character of the cortication, three varieties may be recognized (see key): *C. sinicola* var. **typicum** nom. nov., *C. sinicola* var. *Johnstonii* (S. & G.) Dawson, and *C. sinicola* var. *interruptum* (S. & G.) Dawson.

Since *Ceramium sinicola* is already well known as an abundant and widely distributed species epiphytic on various algae throughout the Gulf of California, further collections need not be cited for that area. Its occurrence along the Pacific Coast of California and Baja California may be outlined, however, by the following collections: CALIFORNIA — Hollenberg 624.6, Whites Point, San Pedro; Hollenberg 797, 812, Santa Catalina Island; Hollenberg 581.6, 1598, Corona del Mar; Dawson 316, 2084, 5422, La Jolla. BAJA CALIFORNIA — Dawson 246, Punta Descanso; 1161, Punta Baja; 6707, Isla Magdalena (Pacific side); 6902, Cabeza Ballena; 2953, Miller's Landing.

5. CERAMIUM OBESUM sp. nov.

Plate 1, figs. 7–9

Thallis prostratis, repentibus, rhizoidum plurium (ubi contactum factum) ope affixis, cylindricis, 90–1100 μ diametro, totis bene corticatis, ramulis secundariis numerosis spinescentibus donatis; cortice bistratoso ad 300 μ crasso.

Plants prostrate, creeping, growing over themselves and other small algae and debris, attaching by masses of small rhizoids produced from all contacting surfaces, very coarse, cylindrical, 900–1100 μ diam., with axes 20–22 mm. long, completely corticated throughout, abruptly reduced at the apex to the short, coarse, strongly forcipate tips; primary branching dichotomous, infrequent; secondary branching irregular, frequent, consisting mostly of very short branchlets with strongly circinately curved tips; cortex very thick, completely covering the axes, consisting of an inner layer of thick-walled rotund cells 25–100 μ diam. adjoining the central axial cells which are about 400 μ diam., and an outer layer of densely packed small anticlinally elongated cells 15–25 μ long by 5–9 μ wide; reproduction not seen.

TYPE: Dawson 964, on intertidal rocky shore at Bahía Agua Dulce, Isla Tiburón, Sonora, Mexico, February 21, 1946. HAHF 5279.

This extremely robust species is suggestive in anatomy and gross morphology of *Ceramium crassum* Okam. of Japan, but its prostrate, creeping habit and rhizoidal attachment among mat-forming small algae distinguishes it from that erect, epiphytic species.

6. CERAMIUM VISCAINOENSE sp. nov.

Plate 1, figs. 1–3

Thallis 15–25 mm. altis, rosulatis, saxicolis, pro more dichotome ramosis; ramis adultioribus 400–500 μ diametro, nodis constrictis; cortice toto continuo; ramis secundariis proliferis brevibus, multifariis, supra congestis; apicibus divergentibus, acutis; tetrasporangiis immersis.

Thalli 15–25 mm. high, tufted, saxicolous, attached by massed and coalesced short rhizoids which in mature plants form a spongy disc, consisting of several to many dichotomously branched axes arising from the base; older branches 400-500 μ diam., catenately constricted at the nodes, gradually reduced in diameter above and the constrictions less prominent; secondary proliferous branches multifarious, short, increasingly abundant and more congested above; ultimate branches divergent, non-forcipate, acute; cortex continuous throughout, primarily of irregularly disposed small angular cells and a few larger cells at the junction of the rotund axial cells, generally thin or incomplete over the bulging midparts of the central axial cells, the longitudinally arranged small, mostly elongated cells of young segments becoming in part increasingly longer or even filamentous as secondary, acropetal and basipetal cortical growth progresses; tetrasporangia 30–35 μ diam., completely immersed in the cortex; cystocarps surrounded by 3–5 involucral branchlets.

TYPE: Dawson 1430, intertidal rocky shore at Punta Santa Rosalía, Baja California, Mexico, April 13, 1946. HAHF 5225.

Ceramium viscainoense shows by its microscopic characters a similarity to *C. pacificum*. A comparison of specimens of both species collected at Punta Santa Rosalía on the same day, however, indicates several apparently significant differences. Most conspicuous in *C. viscainoense* are the divergent apices and the dense massing of short, secondary branches in the upper parts of the plant. These short branches are in turn branched, the ultimate segments being spine-like (fig. 2). The prominent constrictions at the nodes and the thin, loose corticating of the internodes (fig. 3) also appear to be characteristic.

7. CERAMIUM PACIFICUM (Collins) Kylin

Plate 4, fig. 30

Kylin, 1925, p. 61; 1941, p. 29; Smith, 1944, p. 326, pl. 83, fig. 3; Dawson, 1945a, p. 67; Doty, 1947, p. 187. *Ceramium rubrum* var. *pacificum* Collins, in Phyc. Bor. Amer. no. 893, 1747.

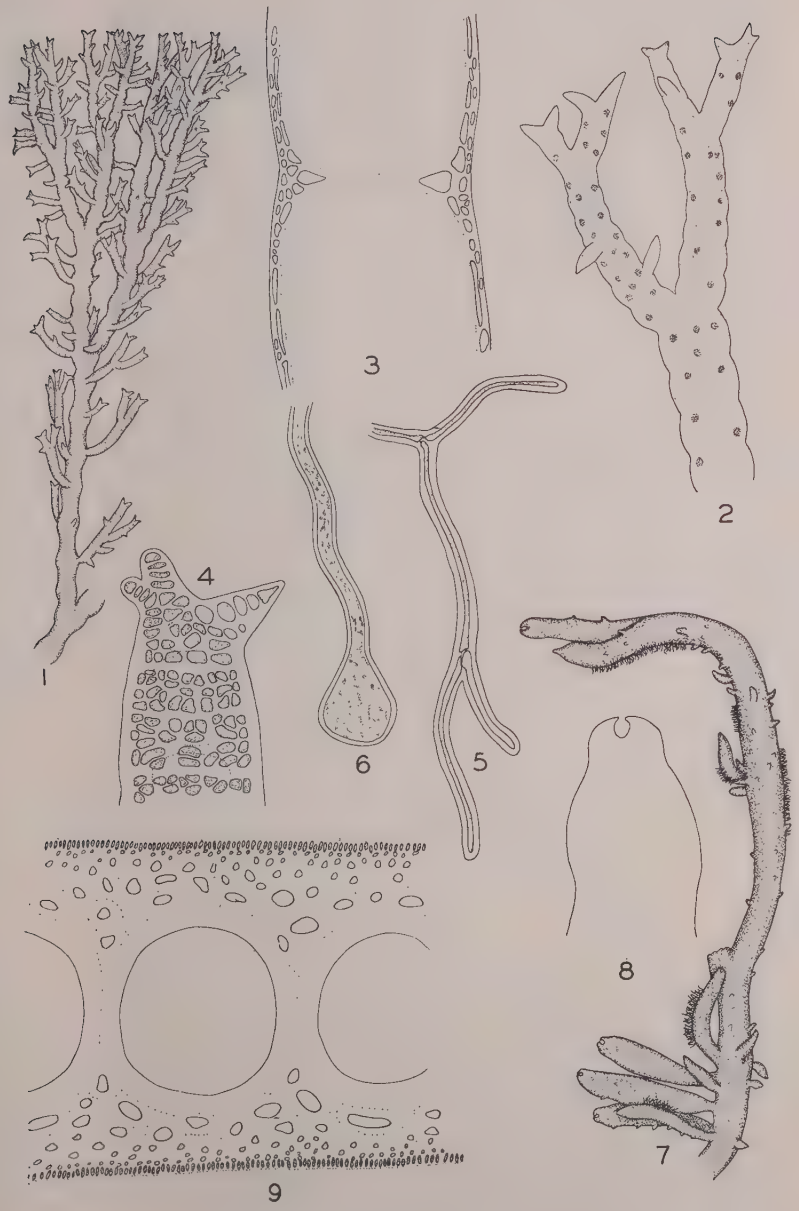
PLATE 1

Figs. 1–3. *Ceramium viscainoense*. **1.** Habit of a portion of the type specimen, × 7.5. **2.** Terminal part of a tetrasporangial branch of the same, × 30. **3.** Longitudinal section of an older node, × 80.

Figs. 4–5. *Ceramium sinicola*. **4.** Apex of a mature branch to show spine, × 300. **5.** Part of a typical branched rhizoid, × 120.

Fig. 6. *Ceramium codicola*. A typical, unbranched, bulb-tipped rhizoid, × 120.

Figs. 7–9. *Ceramium obesum*. **7.** Habit of part of the type specimen, × 5. **8.** Outline of a mature apex to show forcipate tips, × 27. **9.** Longitudinal section through a main branch from the type specimen, × 55.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Widely distributed along the California coast and northward to Vancouver Island, this plant has been reported in Mexico only from extreme northwestern Baja California. Recent collections include several luxuriant examples (Dawson 1509, 1610, 1557) from the area just south of Punta María at the northern edge of Bahía Viscaino.

The specimens of completely corticated *Ceramium* from southern Alaska cited by several authors under *C. rubrum* (see Setchell & Gardner, 1903) have not been reviewed, but they may be expected to represent far northern examples of *C. pacificum*.

8. CERAMIUM WASHINGTONIENSE Kylin

Kylin, 1925, p. 62, fig. 41; Doty, 1947, p. 187.

This northern *Ceramium* appears to be the only one of our coast not to be expected to occur in Mexico. Kylin has pointed out several distinctions from its apparent near-relative *C. pacificum*. It is also notable that the continuous cortication above, with only thin separating lines between the nodes, becomes slightly discontinuous below as a result of the elongation of the internodes at a rate slightly greater than that of the growth (mainly basipetal) of the secondary corticating cell rows.

9. CERAMIUM PANICULATUM Okamura

Okamura, 1921, p. 114, pl. 179, figs. 8–16; Dawson, 1944, p. 319.

First reported in the eastern Pacific from Guaymas, Sonora, this interesting plant has recently appeared in several other Mexican collections: Dawson 1980, 3522, Guaymas, Sonora, 3237, Punta Palmilla, Baja Calif., 6810, Cabeza Ballena, Baja Calif., and 3637, Mazatlán, Sinaloa. It would seem to be restricted to the more tropical waters of the Pacific Mexican coast. Tetrasporangia found on Dawson 3237 are essentially like those of Japanese specimens.

It should be noted that in some cases, as in the Guaymas collections 3522 and 1980, that the spines on some branches may be only scantily developed, or occasionally not at all.

10. CERAMIUM HAMATISPINUM sp. nov.

Plate 3, figs. 20–22.

Thallis in algarum pulvinis intertextis, 90–130 μ diametro, distanter dichotome ramosis, ad nodos tantum corticatis; apicibus circinnatis; nodis verticillo spinarum 5–6 persistentium, crassarum, pro more uncinatarum, multicellularium armatis.

Thalli forming entangled masses amid small, mat-dwelling algae, the filaments 90–130 μ diam., or 50–70 μ diam. in young parts, irregularly and distantly, dichotomously, divergently branched, corticated only at the nodes; apices circinate; nodal cortex 40–60 μ long, of irregularly arranged small, angular cells and producing a whorl of 5–6 usually 3-celled, nondeciduous, stout spines 30–50 μ long with sharp, usually hooked tips, the hook directed basally; internodes elongating early, becoming 100–250 μ long in older filament parts; nodes occasionally with slender, accessory rhizoids; secondary cortical expansion essentially absent; reproduction not seen.

TYPE: Dawson 3706, intertidal, Mira Mar, Nayarit, Mexico, December 20, 1946. HAHF 48800.

This is one of the most distinctive of Pacific *Ceramium* species by manner of the conspicuous whorls of stout, usually hooked spines arising from the middle of each node and persisting throughout the life of the filament.

11. CERAMIUM EVERMANNII Setchell & Gardner

Setchell & Gardner, 1930, p. 169, pl. 8, figs. 28–29.

Although some sterile, southern California specimens such as Hollenberg 3343 from Corona del Mar correspond with this species in their vegetative features, *Ceramium Evermannii* remains positively known only from the type locality, Isla Guadalupe, Baja California. The specimens cited under this name by Dawson, 1945, have proved upon reëxamination to be *Ceramium californicum*, since emergent, rather than immersed, tetrasporangia have been detected.

12. CERAMIUM CALIFORNICUM J. Agardh

Plate 3, fig. 18.

J. Agardh, 1894, p. 45; Kylin, 1925, p. 61; 1941, p. 29; Collins, Holden & Setchell, in Phyc. Bor. Amer. no. 447. *Ceramium Evermannii* Setchell & Gardner, as interpreted by Dawson, 1945a, p. 62.

This species is amply distinct from our other incompletely corticate species by its tetrasporangial and cortical characters. The cortex is of small, irregularly disposed angular cells external to the larger, submerged nodal cells. The outer cortex grows by both basipetal and acropetal expansion such that in older parts it more or less completely covers the internodes. The projecting tetrasporangia distinguish this plant from the apparently closely related *C. Evermannii*.

Specimens are now at hand from several localities of northwest Mexico: Dawson 5164, 5183, 6494, Cabo Colnett; 1167, 1213, Punta Baja; 1510, Punta Santa Rosalía; 6711, Bahía Magdalena. In the latter specimens the internodes are short above and the cortex in lower parts completely covers the internodes. Most of the specimens examined show a more or less distinct constriction of the cortical band at the nodal junction.

13. CERAMIUM FIMBRIATUM Setchell & Gardner

Setchell & Gardner, 1924, p. 777, pl. 26, figs. 43–44; 1937, p. 88, pl. 7, fig. 18; Dawson, 1944, p. 317.

This readily recognized species has heretofore been recorded only from the Gulf of California and from extreme southern Baja California. Recent collections demonstrate its wide occurrence along the Pacific Coast of Mexico: Hollenberg 2571, Punta Banda, Baja Calif., Dec. 1938; Dawson 1407, Punta Santa Rosalía, Baja Calif.; Williams 4/24/46, Scammon Lagoon, Baja Calif.; Dawson 6826, Cabeza Ballena, Baja Calif.; Dawson 3596, Mazatlán, Sinaloa; Dawson 3842a, Acapulco, Guerrero. It is closely related to the group of species including *C. Masonii*, *C. recticorticum* and *C. Taylorii* in which the tetrasporangia are whorled and involucrate, and in which the cortical band is divided at about the lower third into two

distinct parts. In *C. fimbriatum* the cells of this lower cortical part are often horizontally elongated somewhat as in *C. Masonii.*

14. CERAMIUM RECTICORTICUM sp. nov.

Plate 3, figs. 23–24.

Thallis epiphyticis, e filamentis basalibus ope rhizoidum affixis; partibus erectis ad 3 mm. altis, 50–60 μ diametro, ad nodos tantum corticatis, alternatim ramosis; zonis corticalibus e cellulis rectangularibus factis horizontaliter elongatis, seriebus horizontalibus verticalibus bene formatis, opere ad nodi marginem superum tantum interrupto; tetrasporangiis verticillatis, involucratis.

Thalli epiphytic, 1.5–3 mm. high, often densely tufted, attached to the host by prostrate, basal parts of filaments bearing long rhizoids; branching apparently alternate; filaments 50–60 μ in diam. above, with non-forcipate, slightly incurved apices, corticate only at the nodes; cortical bands about 2/3 as long as broad, slightly tumid, consisting, except at the upper margin, of more or less rectangular cells horizontally elongated and arranged in about four definite horizontal and vertical rows, these regular rows maintained and usually unmodified by growth or enlargement below; internodes scarcely evident in uppermost 500 μ of branch tips, lengthening to 10–30 μ somewhat lower, and then elongating markedly to 300–400 μ in the entangled, basal filaments from which verticils of rhizoids arise at the nodes; tetrasporangia 20–25 μ diam., maturing within 300 μ of apex of terminal branches, borne in whorls of 3–5 (mostly 4) within the cortical band which is modified by their expansion to form an involucre; cystocarps and antheridia unknown.

TYPE: Dawson 1769, on *Coeloseira pacifica*, Bahía Bocochibampo, near Guaymas, Sonora, May 16, 1946. HAHF 48795.

Additional material: Dawson 501, 509, 455a, 1706, 1749, 1772, 3566, epiphytic on various hosts, Bahía Bocochibampo, Sonora; 3667, Mazatlán, Sinaloa.

This species differs from closely related *Ceramium Taylorii* by the strikingly regular arrangement of the cortical cells. At Bahía Bocochibampo,

PLATE 2

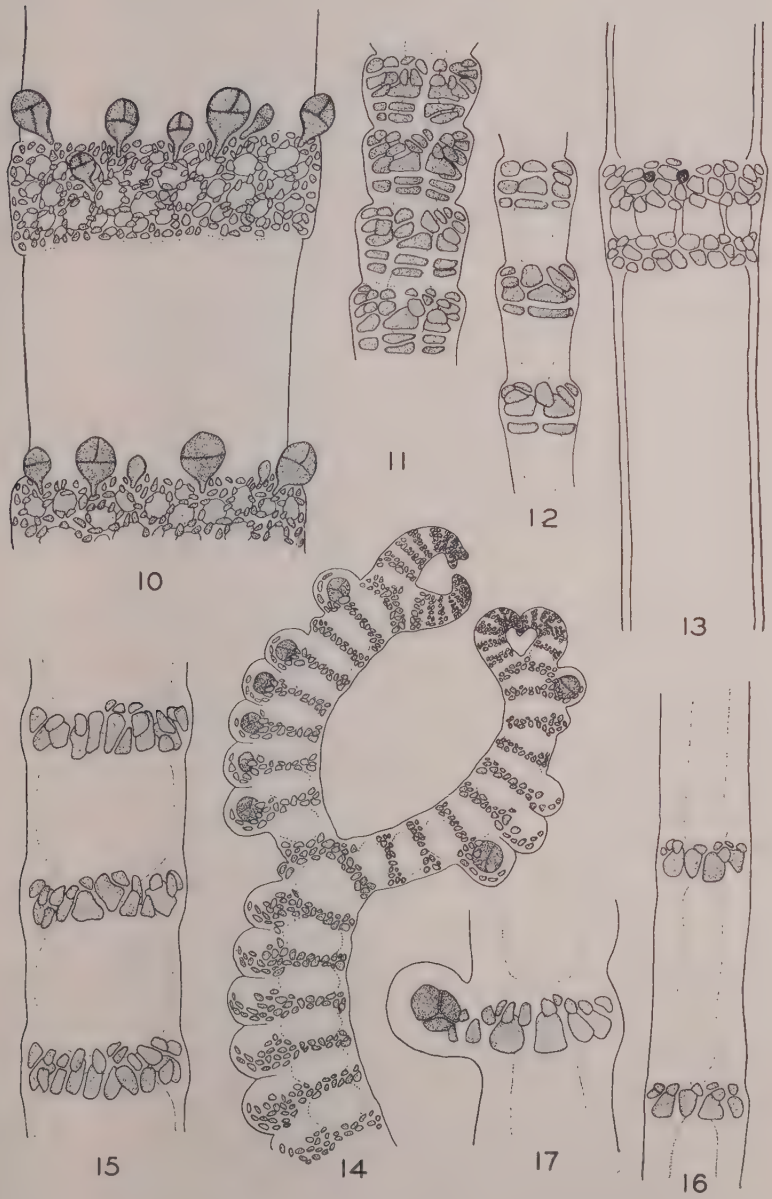
Fig. 10. *Ceramium ornatum.* A portion of a tetrasporangial filament from the type collection, × 125.

Figs. 11–12. *Ceramium Masonii.* **11.** Portion of the upper part of a plant of Dawson 3417 from La Paz, × 250. **12.** Portion of a filament of Dawson 6770 from Cabeza Ballena, × 250.

Fig. 13. *Ceramium Taylorii.* Portion 3 mm. from the tip of a filament of an uncommon form with broader and more medianly situated space between the two parts of the divided outer cortical band (Dawson 3675, Mazatlan) × 250.

Figs. 14–15. *Ceramium mazatlanense.* **14.** Upper part of a tetrasporangial plant to show short nodal bands and abaxial tetrasporangia, × 125. **15.** Part of a filament 1.5 mm. from the apex of a mature tetrasporangial plant of the type collection, × 250.

Figs. 16–17. *Ceramium affine* var. *peninsularis.* **16.** A sterile part of a filament from the type collection, × 225. **17.** A tetrasporangial node from the type specimen, × 330.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where both species have been found growing together, they are easily distinguished.

15. CERAMIUM MASONII sp. nov.

Plate 2, figs. 11–12

Ceramium gracillimum Griffiths & Harvey, as interpreted by Dawson, 1944, p. 319. *Ceramium transversale* Collins & Hervey, as interpreted by Setchell & Gardner, 1930, p. 170, pl. 7, figs. 23, 24; Collins, Holden & Setchell, in Phyc. Bor. Amer. no. 2150.

Thallis epiphyticis ope rhizoidum affixis e filamentis inferis subprostratis vel intertextis orientibus, 4–5 (10) mm. altis, 40–50 μ parte supera diametro, parte infera 60–80 μ diametro tantum, ad nodos corticatis, alternatim ramosis; zonis corticalibus in tertio infero linea perspicua partitis, zonae ipsius tertio infero seriebus 1–2 cellularum elongatarum horizontaliter facto; tetrasporangiis verticillatis, involucratis.

Thalli epiphytic, attached by rhizoids from the nodes of semi-prostrate or entangled lower filaments, to 4–5 (or 10) mm. high, 40–50 μ diam. above, 60–80 μ diam. below, corticated only at the nodes, without secondary cortical expansion; branching apparently alternate; apices non-forcipate, slightly incurved; internodes long below, to 5 times the nodal diameter; cortical bands divided in their lower third by a clear line, consisting in the upper two thirds of larger, angular cells cutting off a few smaller, superficial cells, the lower third of 1–2 tiers of horizontally elongated cells; tetrasporangia whorled, borne within the cortical band which is modified by their growth to form an involucre; antheridia in whorled tufts at the nodes.

TYPE: Dawson 6756, epiphytic on *Galaxaura*, Cabeza Ballena, Baja California, Mexico, March 11, 1949. HAHF 48796.

Additional material: MEXICO — Dawson 6770, Cabeza Ballena; 3442, 3417, Bahía de La Paz; 470, Bahía Bocochibampo, Sonora; 3518, Ensenada de San Francisco, Sonora; 6730, Punta Frailes, Baja Calif.; 6631, Isla Margarita, Baja Calif.; Williams 5/14/46, Isla Cedros, Baja Calif.; Hubbs 46–144, Isla Guadalupe, Baja Calif., Dec. 1946 (identical with the specimens originally collected by Mason on Isla Guadalupe and assigned to *C. transversale* by Setchell & Gardner). CALIFORNIA — Hollenberg 2227, Corona del Mar, Dec. 1937; Phyc. Bor. Amer. 2150, Laguna Beach, Feb. 1913.

Study of the several species of Mexican *Ceramium* in which the cortical band is divided in its lower third has led to a reëxamination of the *Ceramium gracillimum* of Europe and the possibly synonymous *C. transversale* of the western Atlantic and Caribbean in an effort to determine more accurately the relationships of the Pacific Coast plant. At the outset it is assumed that the name *C. byssoideum* Harvey is to be considered synonymous with *C. gracillimum* Griffiths & Harvey in accordance with the studies of Feldmann-Mazoyer (1940). A comparison, then, of the Pacific plants and those of Europe recognized under the latter name has shown some significant differences. Chief among these are a greater regularity of the elongated cells of the lower part of the cortical band in the Pacific plant, the involucrate, whorled, tetrasporangial arrangement, and the absence of the conspicuous gland-cells of *C. gracillimum*. These dif-

ferences appear to indicate that the Pacific American plants are not conspecific with the European. As for *C. transversale* Collins & Hervey, an examination of some of the type material from Bermuda shows no apparent vegetative difference, though the manner of production of tetrasporangia appears to be unlike that in the Pacific specimens. In *C. transversale* the tetrasporangia are sub-secund and only 1–2 at a node, while in the Pacific plants the tetrasporangia are regularly whorled and in groups of 3 or more.

Inasmuch as there appear to be many uncertainties in an attempt to identify our Pacific Coast specimens either with the European *C. gracillimum* or with the doubtfully distinct western Atlantic *C. transversale*, and in view of the apparent tetrasporangial differences in *C. Masonii*, it has seemed best to consider our Pacific plant as an independent species. The taxonomic history of many other of our plants earlier identified with Atlantic species lends support to this view.

16. CERAMIUM TAYLORII sp. nov.

Plate 2, fig. 13; Plate 4, figs. 31–33

Ceramium fastigiatum Harvey, as interpreted by Taylor, 1945, p. 271 (in part). *Ceramium gracillimum* Griffiths & Harvey, as interpreted by Hollenberg, 1948, p. 158.

Thallis ope rhizoidum affixis a filamentis basalibus prostratis orientium; partibus erectis 5–16 mm. altis, diametro supra 60–80 μ, subtus ad 180 μ, ad nodos tantum corticatis, alternatim ramosis; zonis corticalibus subtumidis, in tertio infero linea perspicua partitis; zonae ipsius tertio infero in cellulis parvis angularibus partito; tetrasporangiis verticillatis, involucratis.

Thalli epiphytic or saxicolous, arising from prostrate filaments adhering by rhizoids from the ventral nodal surfaces, the erect parts to 5 (or to 16) mm. high, 60–80 μ diam. above, to 180 μ diam. below, apparently alternately branched; tips non-forcipate, divergent or somewhat incurved in youth; cortical bands somewhat tumid, about 2/3 as long as broad, separated by internodal spaces of 40 μ or less above, but sometimes to 150 μ below (or rarely to 700–800 μ in unusual plants of lax habit), divided in the lower third into two parts by a clear line, the cells in the lower third often at first horizontally elongated, but ultimately divided up into small, angular cells, the upper part of the band consisting of several larger, deep-seated cells cutting off smaller cells toward the top and outside of the band; tetrasporangia whorled, 2–6 at a node, about 30 μ diam., borne within the tumid upper 2/3 of the divided cortical band which becomes modified by their expansion to form an involucre; old branches bearing empty involucres appearing catenate; antheridia borne in a more or less continuous superficial layer on terminal branches above the region of internodal elongation, tending to be confined to adaxial surfaces; cystocarps borne terminally, surrounded and completely overarched by 5–6 long, clasping, involucral branches.

TYPE: Dawson 3393, Cabeza Ballena, Baja California, Mexico, November 9, 1946. HAHF 48797.

Additional material: PACIFIC BAJA CALIFORNIA — Dawson 211a, Punta Descanso; 7268, Bahía Santa María, Isla Magdalena; 1644, El Cardón,

near Punta María; 1576, 1587, Bahía Los Ositos; 2814, 1425, Punta Santa Rosalía; 6708, Bahía Magdalena. GULF OF CALIFORNIA — 613, 617, 1898, 1962, 1969, 1982, 3520, Ensenada de San Francisco; 759, 786, 724, 744, 800, Isla Patos; 1002, 1018, Isla Partida; 1039, Isla Raza; 7176, Puerto Escondido; 7051, Isla Carmen; 3401, 3368, 3342, 3320, Cabeza Ballena. SINALOA — 3658, 3599, 3675, 3623, 3618, Mazatlán. NAYARIT — 3704, Mira Mar. GUERRERO — 3878, 3899, Acapulco.

Several specimens collected by Hollenberg in southern California, particularly at Laguna Beach, have been seen and verified as this species.

A comparison of Taylor's Mexican specimens with recent collections from Pacific Mexico and with typical *Ceramium fastigiatum* from the Atlantic revealed that two different species are involved. Superficially, in size, habit and in the tumid appearance of the cortical bands, *C. Taylorii* resembles *C. fastigiatum*, but in structure of the cortex they are quite distinct. *C. Taylorii* is particularly easily recognized by the fact that the cortex is divided by a distinct horizontal line, usually in its lower third, into two parts in which cell divisions in each are such as not to obscure or disrupt this line. In *C. fastigiatum* such a division of the cortex does not occur and the cells of the band are irregularly disposed with no special horizontal or vertical arrangement. This division of the cortex is similar to that in *C. Masonii*, but in that plant the cells of the lower part of the cortical band are distinctly horizontally elongated and remain so, while in *C. Taylorii* they become divided up in an angular manner. In *C. Masonii* the number of cell rows in the lower cortical third is usually at first one, later two. In *C. Taylorii* this lower part of the band is broader, usually of two tiers at first, later three or sometimes four. The division into angular cells may sometimes result in horizontally elongated cells, but these are of irregular shape and disposition.

17. CERAMIUM PROCUMBENS Setchell & Gardner

Setchell & Gardner, 1924, p. 772, pl. 27, figs. 51–54; Dawson, 1944, p. 318; Hollenberg, 1948, p. 158.

This small, epiphytic plant with extensive prostrate parts and conspicuous opposite branching, first reported in the Gulf of California, has been shown by Hollenberg to be a common epiphyte along southern California. He has also collected it on Santa Catalina Island, California (Hollenberg 759, April 1935). His California specimens have been verified and compared with material from various hosts taken both along Pacific Baja California (Dawson 2763, 2800, Punta Santa Rosalía) and in the Gulf of California (1323, Bahía de Los Angeles, Baja Calif.; 1816, Ensenada de San Francisco, Sonora).

18. CERAMIUM EQUISETOIDES Dawson

Dawson, 1944, p. 320, pl. 51, fig. 1. *Ceramium sinicola* var. *interruptum* (Setchell & Gardner) Dawson, as interpreted by Hollenberg, 1948, p. 158 (in minor part).

The type has been reëxamined and compared with several new collections from the Gulf of California. It now appears that this species may

be related, because of its immersed tetrasporangia, both to *Ceramium procumbens* and to *C. sinicola*, from which it is distinguished, respectively, by its lack of opposite branches, and by its characteristically elongated internodes and proportionally short cortical bands. In some instances the tetrasporangial branches are 2–3 times forked and occasionally with the swollen fertile parts interrupted just above the dichotomies by 1–2 vegetative segments with ecorticate internodes, somewhat as in *Ceramium sinicola* var. *interruptum*.

Recent collections from five stations between Puerto Libertad, Sonora and La Paz, Baja California confirm the wide range within the Gulf of California. Hollenberg's material from Balboa Harbor, California, including his no. 1082, Oct. 1935, agrees with this species. Its occurrence in the protected harbor appears to be in accord with the ecological requirements of the species as indicated by its habitat in the Gulf of California.

19. CERAMIUM SERPENS Setchell & Gardner

Setchell & Gardner, 1924, p. 775, pl. 27, fig. 58; Dawson, 1944, p. 318.

This species is similar in size and in the involucrate tetrasporangia to *Ceramium Camoui*, but the tetrasporangia are usually solitary at the nodes rather than in whorls. The involucre, thus, is unilateral. Plants may be much taller than the type, though of the same filament diameter. Dawson 3132 from La Paz, Baja California is topotypic, but is more than 10 mm. high, with elongated internodes below. A collection from Punta Palmilla, Baja California, Dawson 3264, contains specimens identical with the type illustration.

Perhaps related here is a plant from Cabo Pulmo, Baja California, Dawson 3097, epiphytic on *Dictyota crenulata*. It has solitary, emergent, non-involucrate tetrasporangia and heavier cortical bands with more tiers of cells than in *Ceramium affine*.

20. CERAMIUM CAMOUII Dawson

Dawson, 1944, p. 319, pl. 51, figs. 2–3.

This minute, inconspicuous plant with its highly developed tetrasporangial involucres grows entangled amid other microscopic algae on rock surfaces. Since it seems not to occur in pure stands of its own kind, it is easily overlooked and its presence has been detected thus far only in two of the recent Mexican collections: Dawson 1751, entangled with *Centroceras*, Bahía Bocochibampo, Sonora; 3467, entangled with *Polysiphonia*, La Paz, Baja California. A tetrasporic collection by Hollenberg, 2545, from the bay side of Punta Banda, Baja California, is identical with Dawson 1751 and places this species for the first time in the flora of the outer Pacific Coast. The cortical bands of *C. Camoui* are conspicuously tumid, extremely so when bearing tetrasporangia, and the internodes characteristically long.

21. CERAMIUM GARDNERI Kylin

Plate 3, fig. 19.

Kylin, 1941, p. 29; Smith, 1944, p. 325, pl. 84, fig. 2. *Ceramium californicum* J. Agardh, as interpreted by Gardner, in Phycotheca Boreali-Americana no. 2248.

Although this species has not been reported in California south of Monterey, two specimens in agreement with cotype material in the Hancock Foundation copy of Phyc. Bor. Amer. are at hand: Cooper 470, Dec. 1946 from Ventura, and Hollenberg 1325, April 1936, from Santa Cruz Island. It has not yet been identified with certainty in the Mexican collections.

Ceramium Gardneri is similar to *C. personatum* and may be distinguished by its tetrasporangia which are initially secund and adaxial. In *C. personatum* the tetrasporangia are at first abaxial.

The plants from Puget Sound and Vancouver Island cited by Collins (1913) as *Ceramium tenuissimum* (Phyc. Bor. Amer. 1298) and as *C. strictum*, are apparently related to *C. Gardneri* and are in need of further examination.

22. CERAMIUM MAZATLANENSE sp. nov.

Plate 2, figs. 14–15.

Thallis epiphyticis, 3–4 mm. altis, ope rhizoidum e filamento prostrato nascentium affixis, 90–110 μ diametro, ad nodos tantum corticatis; zonis corticalibus parvis, 25–30 μ, cellulis angularibus; tetrasporangiis emergentibus, secundis, 1–3 aggregatis in facie abaxiali ramorum, involucratis.

Thalli epiphytic, 3–4 mm. high, attached by rhizoids from the ventral surface of a prostrate, basal part of a filament; erect filaments 90–100 μ diam., rather irregularly dichotomously branched, corticated only at the nodes, without secondary cortical expansion; apices forcipate; cortical band very short, 25–30 μ long, consisting of angular cells 7–25 μ in greatest diameter, the largest below and beneath, bearing numerous fine hairs; internodes elongated below, sometimes to 150 μ; tetrasporangia projecting, secund, borne singly or in groups of 2–3 at the nodes on the abaxial sides

PLATE 3

Fig. 18. *Ceramium californicum*. Part of a filament 1 cm. below the apex, from Dawson 5164, Cabo Colnett, × 100.

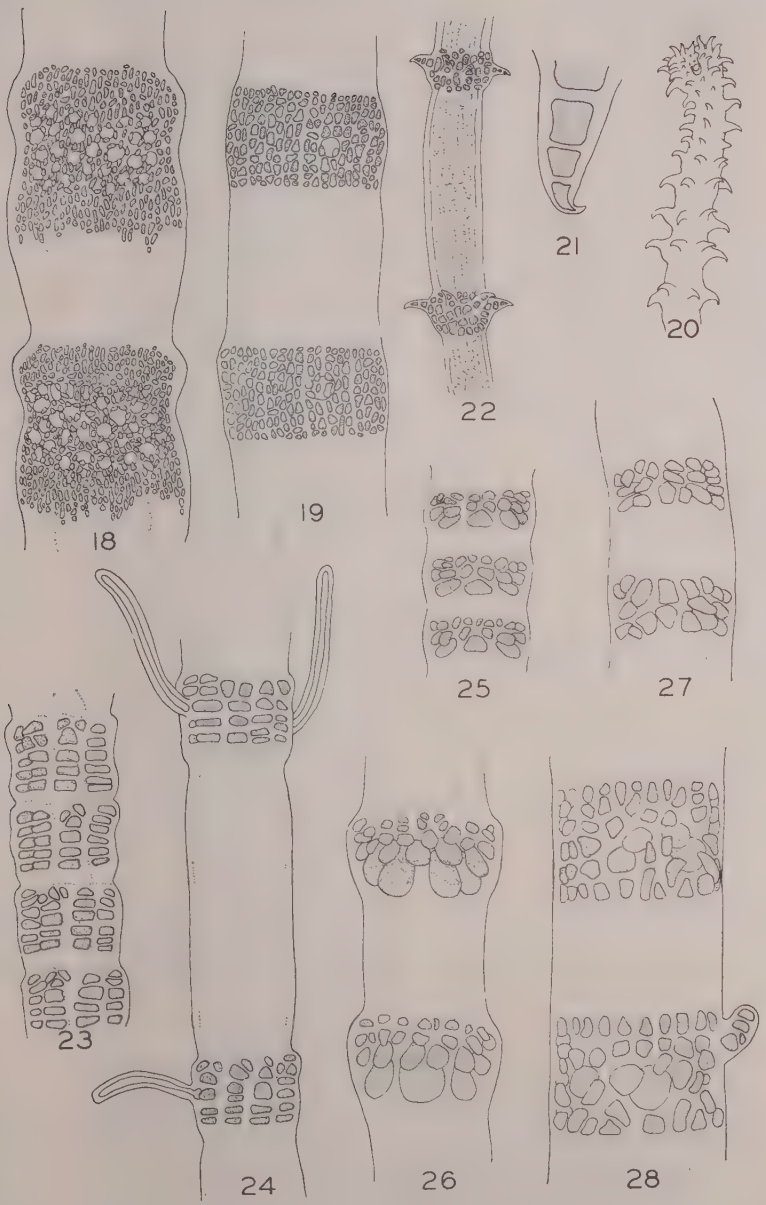
Fig. 19. *Ceramium Gardneri*. Part of a filament 1 cm. below the apex, from a cotype specimen in Phyc. Bor. Amer. no. 2248, × 100.

Figs. 20–22. *Ceramium hamatispinum*. **20.** Terminal part of a young filament from the type collection to show abundant spines and circinate tips, × 85. **21.** Detail of multicellular, hooked spine, × 550. **22.** Part of an old filament to show persistent, whorled spines, × 100.

Figs. 23–24. *Ceramium recticorticum*. **23.** A series of cortical bands from a subterminal portion of the type specimen, × 250. **24.** An older portion of a filament of the type specimen showing persistence of vertical rows of cells, the long internodes and rhizoids, × 250.

Figs. 25–26. *Ceramium avalonae*. **25.** A series of nodes near the apex of a topotype specimen, × 225. **26.** An older portion of a filament of the same plant to show lower nodes, × 350.

Figs. 27–28. *Ceramium zacae*. **27.** Young nodes of a plant from the type collection, × 225. **28.** Lower nodes of a plant from the type collection, × 350.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of the branches, about 35 μ diam., half enveloped by a cortical involucre; antheridia in low, pulvinate masses at the nodes, partially or completely encircling them; cystocarps not seen.

TYPE: Dawson 3606, epiphytic on *Codium*, Mazatlán, Sinaloa, Mexico, December 8, 1946. HAHF 48798.

Additional material: Dawson 3815, 3819, at granite headland south of Salina Cruz, Oaxaca, Mexico, Jan. 1947; Dawson 40–657, rocky point just north of Kino, Sonora, July 16, 1940.

This species has a nodal structure suggestive of *Ceramium Gardneri* though the cortical bands are much shorter. The solitary, abaxial, involucrate tetrasporangia are further distinctive as well as the presence of creeping filaments "rooting down" to the host. The tetrasporangial specimens from Salina Cruz show regularly abaxial, strongly involucrate tetrasporangia, but do not have the circinately curved tips of the type. Their apices are more attenuate than those of the type and but slightly forcipate.

23. CERAMIUM AFFINE Setchell & Gardner

Plate 2, figs. 16–17.

Setchell & Gardner, 1930, p. 172; Dawson, 1944, p. 317, pl. 51, fig. 4.

The type material of *Ceramium affine* from Isla Guadalupe, Baja California apparently represents a slender variant of this species. Recent collections contain examples identical in form and reproduction with the type, but of larger size. The only specimens known in which the filament diameter is as small as in the type (24–28 μ) are those from Puerto Refugio in the Gulf of California (see Dawson, 1944). The large form of this species, found in several collections from Mexico and in one from southern California, exhibits vegetative characters of nodal cortication and internodal elongation virtually identical with the type, though the plants are of fully twice the size in all dimensions. Despite this range of size among vegetative parts of the two variants, the tetrasporangia are essentially the same in each: about 40 μ in diameter including the thick, hyaline envelope.

The name *Ceramium affine* var. **peninsularis** var. nov. is proposed for the large variant.

Cum speciei forma typica optime quadrante, at partis vegetativis duplo majore; tetrasporangiis pro ratione minoribus, formae typicae accedentibus.

Like the type of the species but twice the size in all vegetative dimensions, 60–70 μ diam.; tetrasporangia as in the type, approximately 40 μ diam.

TYPE: Williams, April 27, 1946, dredged in 4–6 m., Isla Concha, Scammon Lagoon, Baja California, Mexico. HAHF 48799.

Additional material: Williams, May 1946, Scammon Lagoon, Baja California; Dawson 6892, Punta Frailes, Baja Calif.; Hollenberg 1590, Corona del Mar, California, Nov. 1936.

The plant identified by Taylor, 1939, as *Ceramium fastigiatum* forma, from Punta Gorda, Baja California, is probably the same as the present plant.

It is proposed to designate the small variant represented by the type of the species as *Ceramium affine* var. **originale** nom. nov.

The plant from Ecuador referred questionably to *Ceramium affine* by Taylor, 1945, has been reëxamined. Although the tetrasporangial arrangement is similar, it appears to be an entirely distinct species.

24. CERAMIUM PERSONATUM Setchell & Gardner

Setchell & Gardner, 1930, p. 171, pl. 6, figs. 21–22.

Heretofore known only from Isla Guadalupe, this species has been detected in recent collections from the northern Bahía Viscaino. It seems closely related to *Ceramium Gardneri*, but may be distinguished by its tetrasporangia which are initially secund and abaxial, later becoming whorled. There may be considerable resemblance to *Ceramium zacae* in some instances, especially in tetrasporangial parts, but *C. zacae* differs by its short, lower internodes and non-tumid cortical bands, as well as by its non-bracteate tetrasporangia. The descending rhizoidal appendages within the internodal cells reported in the original description have been seen in each of the specimens and appear to provide a good specific character. Three collections from Pacific Baja California are referable here: Dawson 1511, Punta Santa Rosalía; 1575, 1594, Bahía Ositos. All have abaxial tetrasporangia more or less clearly involucrate by bracteate filaments. The Bahía Ositos collections include specimens up to 25 mm. high with quite tumid nodes and many secondary branchlets.

The specimens from Costa Rica referred questionably to this species by Taylor, 1945, are sterile and cannot be identified with certainty.

25. CERAMIUM AVALONAE Dawson

Plate 3, figs. 25–26.

Dawson, 1949, p. 17, pl. 5, fig. 31, pl. 14, fig. 56.

Ceramium avalonae shows considerable superficial, microscopic resemblance to *C. zacae* and has a similar tetrasporangial arrangement. The branching habit and the structure of the nodal cortication, however, are amply distinct. The disposition of the large cells in the lower part of the node, cutting off smaller cells above and toward the outside is a character which persists in older parts of the filaments. The outer cortical cells of *C. zacae* are irregularly arranged. In it the larger cells lie interior to the smaller ones and are ordinarily situated in the middle of the nodes rather than in the lower part. *C. zacae* is more abundantly branched above than *C. avalonae*, and the older nodes are not tumid as in the latter. The lower internodes of *C. zacae* are relatively shorter than in *C. avalonae*, being less than as long as wide, rather than 1.5 times as long as wide or more. New materials show that the tetrasporangia of *C. avalonae* are not necessarily solitary at the nodes as originally described, though the abaxial arrangement is maintained even when two or more tetrasporangia are produced at a node.

Several collections by the writer and by G. J. Hollenberg from the type locality, Santa Catalina Island, California have yielded *Ceramium avalonae*.

A tetrasporic specimen from Isla Guadalupe, Hubbs 12/7/46, extends its range into Mexican waters.

26. CERAMIUM ZACAE Setchell & Gardner

Plate 3, figs. 27–28.

Setchell & Gardner, 1937, p. 89, pl. 8, figs. 22a–22c; Dawson, 1945a, p. 62.

Recent collections by Hubbs, 8/20/46, from Isla Cedros near the type locality of *Ceramium zacae* at Bahía San Bartolomé, have yielded typical mature examples of this species. These plants show clearly the short internodes which distinguish *C. zacae* both from *C. avalonae* and *C. caudatum*. From *C. caudatum* it also differs by its non-tumid nodes which are not provided with whorled rhizoids or secondary uncinate branches as in that species.

The original description states that the tetrasporangia are arranged in two regular rows, one on each flank of the upper dichotomies, but re-examination of material from the type collection shows that the tetrasporangia are often whorled in groups of three or more at a node.

Some collections from southern California which serve to extend the known distribution of this species northward are: Dawson 343, La Jolla; Hollenberg 584.5, Corona del Mar; Dawson 5674, Santa Catalina Island.

27. CERAMIUM CAUDATUM Setchell & Gardner

Setchell & Gardner, 1924, p. 776, pl. 27, figs. 55–57; Dawson, 1944, p. 317.

Ceramium caudatum is a rather variable species which sometimes is difficult to determine by means of the key. It is in some ways similar to *C. zacae*, to *C. avalonae* and to *C. personatum*, particularly in its tetrasporangial parts. From *C. zacae* it is easily distinguished by its longer, lower internodes and tumid cortical bands. From *C. avalonae* it differs in larger size, in the irregular disposition of the cells of the cortical band, and in the whorled rather than typically abaxial tetrasporangia. From *C. personatum* it is distinct in its lack of descending appendages within the internodal cells and in the non-involucrate or non-bracteate tetrasporangia.

Ceramium caudatum is often provided with characteristic whorled rhizoids at the nodes and commonly produces uncinate accessory branchlets.

This species has recently been detected in several collections from the Gulf of California, the most typical being Dawson 3480, Bahía Empalme, Sonora, and 857, Isla Jorge, Sonora. Hollenberg has found typical material in southern California: Hollenberg 644, upper Balboa Harbor, and Hollenberg 820, Santa Catalina Island. A collection by Hubbs, 12/7/46, from Isla Guadalupe also appears to be referable here.

28. CERAMIUM CLARIONENSIS Setchell & Gardner

Plate 4, fig. 29.

Setchell & Gardner, 1930, p. 170, pl. 7, figs. 25–27.

The present study has shown that this plant is a common and easily recognized species both in the Gulf of California and along the Pacific Coast of southern California and Baja California. The moderately large

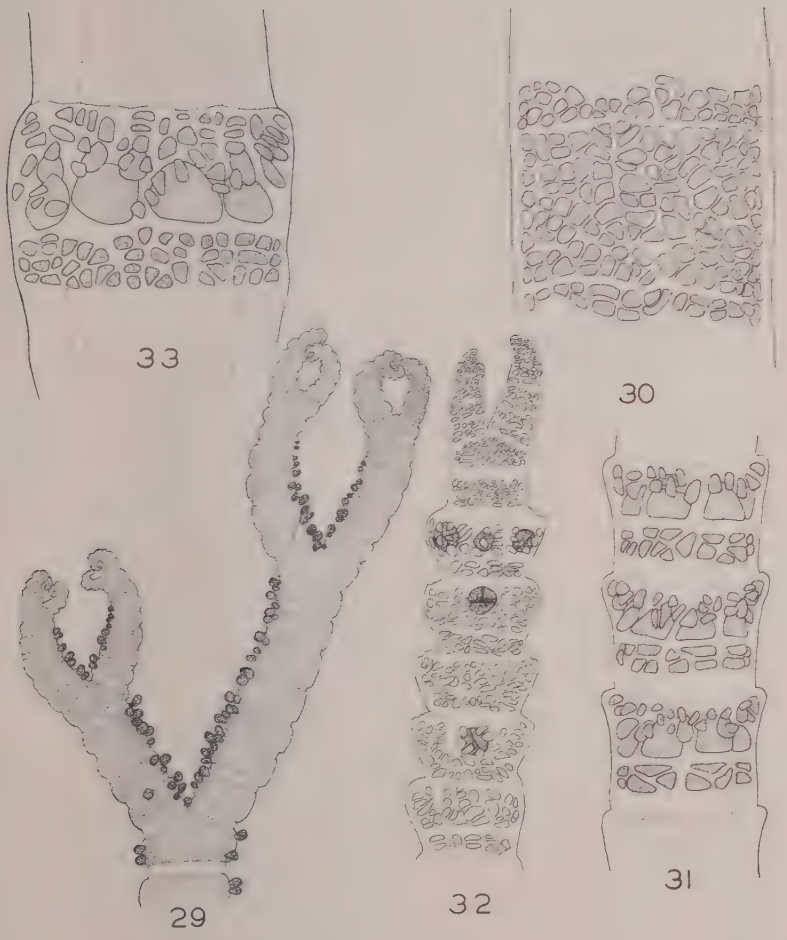

PLATE 4

Fig. 29. *Ceramium clarionensis.* Profile of a terminal portion of a tetrasporangial plant from Guaymas, Sonora, showing adaxial fertile areas, × 55.

Fig. 30. *Ceramium pacificum.* A young node from Dawson 1610, Bahía Viscaino, × 235.

Figs. 31–33. *Ceramium Taylorii.* **31.** A series of young nodes from mithin 1 mm. of the apex of a filament, showing distinct division of the cortical band, × 250. **32.** Terminal part of a tetrasporangial branch showing involucrate condition, × 150. **33.** An older, lower node showing small, angular cells of lower portion of cortical band, × 250.

size, the strongly circinate apices and the truncate cortical bands becoming tumid below, are distinctive vegetative characters. The production of numerous, emergent tetrasporangia, sometimes all the way around the node, or commonly only on the adaxial side, without cortical modification, is a distinctive reproductive character. The tetrasporic characters of the type material have been reëxamined and found not to be represented clearly in the original description or illustration. The tetrasporangia are not as fully developed in numbers on the type as in some of the new material, but those present show a much more clearly emergent, projecting character than is indicated by the Setchell and Gardner illustration. Furthermore, the occurrence of bracteate filaments associated with the tetrasporangia are neither of regular nor of conspicuous occurrence in the type material reëxamined. Such filaments within the tetrasporangial wall are not ordinarily present in the other collections now at hand.

Although short hairs may be present or absent, almost every specimen exhibits to some degree the presence, external to the cortical cells, of small, often globular masses of material staining deeply with aniline blue. These globules are often extremely conspicuous and in some cases are obviously exudation products for they occur external to the cell membrane and in contact with the cortical cell by means of a slender extension of the cell contents through the wall to the exterior. Sometimes the globules are of such regular occurrence and of such uniform size as to give a highly ornamented aspect to the filament (in this regard see Setchell & Gardner, 1930, pl. 7, fig. 25). At other times they may be smeared, giving an unsightly appearance to the slide-preparation. Similar forms suggesting "gland cells" are commonly observed in *Ceramium Taylorii*.

Recorded heretofore only from Isla Clarion, the species is now at hand from many localities along the Pacific Coast. Its distribution may be outlined according to the following collections:

CALIFORNIA — Hollenberg 516, Corona del Mar; Hollenberg 549, Balboa Harbor; Dawson 2088, La Jolla. PACIFIC BAJA CALIFORNIA — Williams 4/30/46, Scammon Lagoon; Williams 5/14/46, Isla Cedros; Dawson 1393, Miller's Landing. GULF OF CALIFORNIA AND SOUTHWARD — Dawson 679, Puerto Libertad, Sonora; 850, Isla Jorge, Sonora; 745, Isla Patos, Sonora; 1018a, Isla Partida, Baja California; 612a, Ensenada de San Francisco, Sonora; 7028, Isla Espiritu Santo, Baja California; 6800, Cabeza Ballena, Baja California; 3696, Mira Mar, Nayarit.

In some instances field records show that these plants produce a brilliant green iridescence in nature. This was particularly true of several from northern localities in the Gulf of California.

A number of recent collections are tetrasporangial, but only those from summer stations. None collected earlier than March shows reproduction. The Mira Mar plant, collected in December, is antheridial, but cystocarpic plants have not yet been noted.

The degree of development of the small, angular cells which usually form a continuous, outermost layer of the cortical band is variable in

this species. In a few cases, notably in Dawson 2813 from Punta Santa Rosalía, Baja California, they may be so scantily developed as to cause the underlying layer of larger cells to appear superficial, thus giving a different appearance to the cortical band.

Those parts of plants in which the tetrasporangia may occur all the way around the node give an appearance strikingly like that in *Ceramium ornatum*. The quite invariably circinate branch-tips of *C. clarionensis*, however, provide a ready distinction from the non-circinate *C. ornatum*.

29. CERAMIUM ORNATUM Setchell & Gardner

Plate 2, fig. 10.

Setchell & Gardner, 1930, p. 172.

This species has not again been detected and may be presumed to be a Guadalupe Island endemic. An examination of part of the type material reveals that the diameter of the main axes is 300–450 μ, rather than 130 μ as given in the original description. Since no illustration has heretofore appeared for this species, a drawing is given from a plant of the type collection.

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LOS ANGELES, CALIFORNIA

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William Lawrence White

May 29, 1908

July 31, 1952

It is with the deepest sorrow that we record the death of William Lawrence White, Associate Professor of Botany and Director of the Farlow Library and Herbarium at Harvard University. He was an eminent mycologist and true friend and counselor to students.